Coastal Protection and Restoration Authority of Louisiana
Office of Coastal Protection and Restoration

2008 Operations, Maintenance, and Monitoring Report

for

Black Bayou Hydrologic Restoration

State Project Number CS-27
Priority Project List 6

April 2009
Calcasieu and Cameron Parishes

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Suggested Citation:

McGinnis, T. and S. Aucoin 2008. 2008 Operations, Maintenance, and Monitoring Report for Black Bayou Hydrologic Restoration (CS-27). *Coastal Protection and Restoration Authority of Louisiana, Office of Coastal Protection and Restoration, Lafayette, Louisiana. 60 pp.*

2008 Operations, Maintenance, and Monitoring Report
For
Black Bayou Hydrologic Restoration (CS-27)

Table of Contents

I. Introduction

The Black Bayou Hydrologic Restoration Project (CS-27) is located in northwest Cameron and southwest Calcasieu Parishes. The project is bordered to the north by the Gulf Intracoastal Waterway (GIWW), to the south by Black Bayou, to the east by Gum Cove Ridge, and to the west by the Sabine River (Figure 1). Total project area is approximately 25,529 acres (10,336 ha) and is comprised of approximately 13,869 acres (5,615 ha) of intermediate/ brackish marsh and 11,660 acres (4,721 ha) of open water. The marshes are dominated by *Spartina patens* (marshhay cordgrass), *Phragmites australis* (Roseau cane), and *Panicum dichotomiflorum* (fall panicum) with associated species such as *Typha sp.* (cattail), *Cladium jamaicense* (sawgrass), *Schoenoplectus californicus* (california bullwhip), *Schoenoplectus robustus* (leafy three-square), and *Juncus roemerianus* (black needlerush).

Historically, the Black Bayou area was a northern watershed of Sabine basin collecting sheet flow from uplands to the north. Black Bayou provided a freshwater head which ran southwest from the uplands near Vinton to the northern rim of Sabine Lake. Beginning in the late 1800s, significant hydrologic changes in the Calcasieu/Sabine basin affecting water level fluctuation and water circulation patterns in the project area has inhibited the freshwater head from north to south and has diverted it to bidirectional, east/west flow (LCWCRTF 2002). Modifications to Calcasieu Pass such as the removal of the Calcasieu Pass oyster reef (1876) and maintenance of a deep (40 ft) and wide (400 ft) Calcasieu Ship Channel has increased the magnitude and duration of tidal fluctuations causing higher salinity and water level fluctuations throughout the lake and the surrounding marshes (LDNR 1993). Construction of the Gulf Intracoastal Waterway (GIWW), North Line Canal, Central Line Canal, and South Line Canal established an east-west hydrological connection between the previously distinct Calcasieu and Sabine basins, disrupting the natural north-south flow and allowing the saline waters of the Calcasieu Basin to encroach on the Sabine Basin. Water level fluctuations are also influenced by wind. A strong north wind can cause drastic de-watering of the marshes, while a strong sustained southerly wind can result in drastic increases in water levels blown in from the Gulf. The extensive system of navigation channels, natural drainage, bayous, oil exploration canals, and trenasses, have allowed increased water fluctuations and salinities to reach the fragile interior marshes in the absence of a strong freshwater head (USDA 1991).

Most of the land loss in this area occurred during between 1956 and 1978 (Barras et al. 2008), as both large and small scale changes have resulted in local hydrologic alterations. The construction of spoil levees along the GIWW disrupted the drainage of uplands to the north causing communities to create more efficient drainage via conversion of Black Bayou to the Vinton Drainage Ditch (Vinton Water Way) which empties into the GIWW and is diverted away from the project area. The east side of the project area gradually developed into an impoundment over time. In addition to the GIWW dredge levee along the north (originally 1913-14; current dimensions since 1941), an oil company access road running east-west along the southern boundary (1950s) and landowner boundary levee running north-south on the west side (1968) created the impoundment which is bordered on the east side by increasing marsh elevations grading into the uplands of the Gum Cove Ridge.

The Black Bayou Hydrologic Restoration Project includes structural and non-structural measures designed to allow freshwater from the GIWW near its confluence with the Vinton Drainage Canal into the wetlands south of the GIWW between the Sabine River, Gum Cove Ridge, and Black Bayou, and to create a hydrologic head that increases freshwater retention time and reduces salt water intrusion and tidal action in the Black Bayou watershed (Figure 1). Black Bayou structural features construction was completed in November 2001. Structural and non-structural features and their intended functions are listed below:

1. Approximately 22,600 linear ft. (6,889 m) of rock foreshore dikes along the GIWW west of the Gum Cove Ridge to repair breaches in the GIWW spoil bank.

2. A weir with a barge bay, 70 ft (21.3 m) wide, with a sill of -7.0 ft NAVD 88, made of graded stone was constructed at the GIWW in the Black Bayou Cut Off Canal to limit water exchange in and out of the project area.

3. A weir with a boat bay, 15 ft (4.6 m) wide with a sill of -4.0 ft NAVD 88, made of graded stone was constructed in the Burton Canal at its intersection with the Sabine River to limit water exchange in and out of the project area.

4. A rock weir with a 15 ft (4.6 m) wide boat bay at - 3 ft NAVD 88 bottom elevation was constructed at the intersection of Block's Creek with Black Bayou to limit water exchange in and out of the project area.

5. A self-regulating tide (SRT) gate, within a sheetpile weir, 40 ft (12.2 m) wide with a sill at + 0.6 ft NAVD was constructed where it connects to an existing canal that leads to Black Bayou Cutoff Canal to limit flow into the impoundment during and increase drainage after high water events. A hinged flap was installed over the weir on either side of the SRT gate in January 2006 to further limit flow into the impoundment while allowing water to drain out.

6. Two, 30 in (0.76 m) flap-gated culverts (Culvert 1/Culvert 2) were installed along the southeastern boundary of the impoundment in January 2006 to relieve excess waters from the impoundment while preventing water flow into the impoundment.

7. Vegetative plantings of *Schoenoplectus californicus* (bullwhip) in two phases. One gallon trade containers with a minimum of 5 stems per container were installed on 5 ft (1.5 m) centers. Phase I, east side of project area on either side of the Black Bayou Cut-off Canal, contained approximately 30,000 plantings spanning 150,000 linear ft (45,720.5 linear m). Phase II, west side of project area, contained approximately 25,570 plantings spanning 127,850 linear ft (38,969.1 linear m).

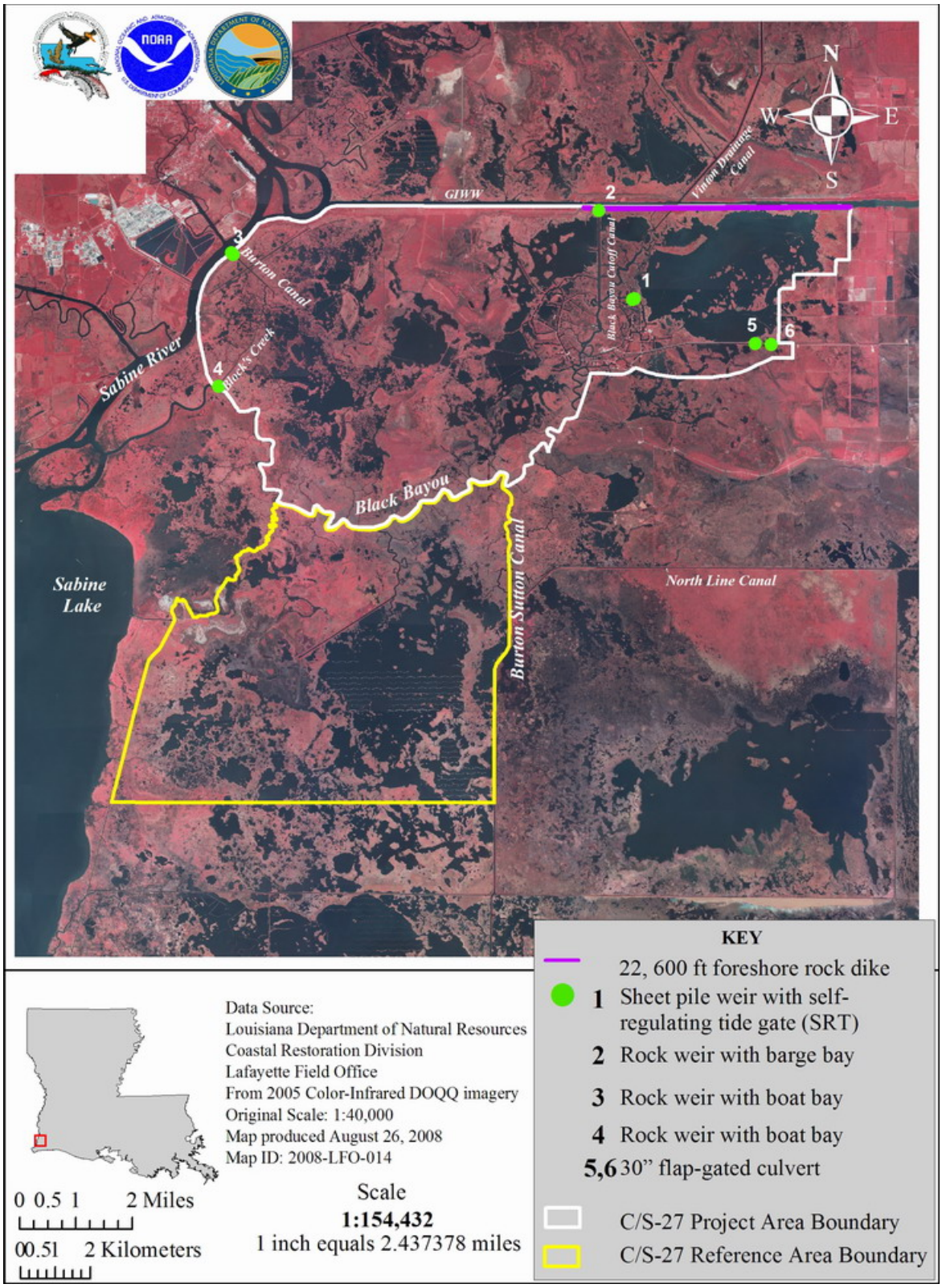


Figure 1. Black Bayou project and reference boundaries and project infrastructure.

II. Maintenance Activity

a. Project Feature Inspection Procedures

The purpose of the annual inspection of the Black Bayou Hydrologic Restoration Project (CS-27) is to evaluate the constructed project features to identify any deficiencies and prepare a report detailing the condition of project features and recommended corrective actions needed. Should it be determined that corrective actions are needed, OCPR shall provide, in the report, a detailed cost estimate for engineering, design, supervision, inspection, and construction contingencies, and an assessment of the urgency of such repairs. The annual inspection report also contains a summary of maintenance projects, if any, which were completed since completion of constructed project features and an estimated projected budget for the upcoming three (3) years for operation, maintenance and rehabilitation. The three (3) year projected operation and maintenance budget is shown in Appendix B.

An inspection of the Black Bayou Hydrologic Restoration Project (CS-27) was held on November 27, 2007 under clear skies and mild temperatures. In attendance were Stan Aucoin, Melvin Guidry, Darrell Pontiff, and Tommy McGinnis of OCPR. NOAA Fisheries representatives were invited but were unable to attend. Also on this trip was Dale Garber of NRCS for an annual inspection of an NRCS project. Parties met at the Lafayette Field Office of CED and proceeded to a boat launch in Vinton, LA. The annual inspection began at the rock weir on Block's Creek.

The field inspection included a complete visual inspection of all features. Staff gauge readings were used to determine approximate elevations of water, rock weirs, earthen embankments, steel bulkhead structures and other project features. Photographs were taken at each project feature (see Appendix A) and Field Inspection notes were completed in the field to record measurements and deficiencies (see Appendix C).

b. Inspection Results

GIWW rock dike

Tie-ins on both the east and west end of the dike are stable. Several random spots along the dike were checked and no apparent toe scour is occurring. As mentioned in previous inspections, the warning signs at both the Vinton and Black Bayou closures have been stolen. The spoil placed behind the rock dike at the Black Bayou Canal has washed away on the western end. Spoil is also gone on the eastern end of the closure at Vinton Canal. There is also a gap in the rock at this location. The second gap from the east has a large gap on the eastern end of the C-stone closure. Rapid water exchange is occurring here and the breach is getting wider and deeper than in previous inspections. The alligator crossing, mentioned in previous inspections, on the 3rd closure from the east has not gotten any worse. These three areas will be addressed with QuickCrete sacks in the maintenance event in the fall of 2008. (Photos: Appendix B, Photos 13-17)

Black Bayou Cut-Off Canal

This component is in immediate post construction condition. No need for maintenance at this time. Conditions of the Navigational Aid Lights are inspected quarterly. (Photos March, '06: Appendix B, Photo 12)

Self Regulating Tide Gate (SRT)

The structure itself is in very good condition. Signage, railings, wingwalls, etc. are in as-built condition. Pillow blocks on new flap have rusted to the point that the flapgate has frozen and cannot move. The entire hinge mechanism will be replaced in the maintenance event which is scheduled for the fall of 2008. (Photos: Appendix B, Photos 7-10)

Rock Plug

Rock has either been moved or has settled slightly to an approximate elevation of +2.5 feet NAVD '88 in spots. Also, eastern end of the dike is well below elevation where it ties into the bank. This will be addressed, with sacks of QuickCrete placed on the crown of the plug and on the tie-in to the bank, in the maintenance event scheduled for the fall of 2008. (Photos: Appendix B, Photo 11)

Blocks Creek

The rock weir is in excellent condition. Signage is stable. The erosion on the SE bank, while has not gotten any worse, will continue to be monitored. No immediate need for maintenance at this structure. Conditions of the Navigational Aid Lights were last inspected in November '07. (Photos: Appendix B, Photos 1-3)

Burton Canal

The weir is in good condition. There is some minor scouring along the canal banks inside of the weir at the end of the dike that will continue to be monitored. Severe current through the weir has caused problems for boaters in the area. The SE arrow sign is missing. As part of the maintenance project scheduled for the fall of 2008, the remaining piling will be removed and warning signs similar to the ones on the Black Bayou Cut-Off canal will be used. The Navigational Aid Lights were last inspected in November '07. (Photos: Appendix B, Photos 4-6)

Culvert 1/Culvert 2

While these culverts were not directly inspected on this trip, they were assumed to be, after conversations with the landowners, in very good, post construction condition and in no need of repair.

c. Maintenance Recommendations

i. Immediate/ Emergency Repairs

None

ii. Programmatic/ Routine Repairs

Repair flap gate hinge connections at the SRT gate, plug gaps on the spoil banks behind the GIWW rock dike, signage along Burton Canal, and cap rock plug at SRT gate.

d. Maintenance History

General Maintenance: Below is a summary of completed maintenance projects and operation tasks performed since December 2003, the construction completion date of the Black Bayou Hydrologic Restoration Project.

December 2003 - Construction Adjustments: Although construction of the original project components was completed in December 4, 2001, it was determined that leaks along the GIWW rock dike would have detrimental effects on the project. The rock dike along the GIWW was removed at four separate locations and plugs consisting of "C" stone were constructed at "water" connections between the marsh area and the GIWW existing to the north to reduce or eliminate tidal flow through these locations. The original signs installed at the Black Bayou Cut-Off Structure on timber pilings were either leaning or missing. Signage was relocated on concrete bases on top of the rock weir. Also, at the SRT gate, a railing was constructed on the sheet pile cap to reduce the chance of persons falling into the water in the area around the structure. This work was completed in December 2003 and construction was considered to have been complete after these adjustments.

July 2003 - Navigational Aid Light Repairs: A letter was received from the US Coast Guard in July 2003 reporting problems with the navigational lights at the Black Bayou Cut-Off Canal weir. The problem was investigated and repaired in October 2003 by Wet-Tech Energy, Inc. at a total cost of $1,250.00.

During March 2006, DNR/CED/LFE, via a Purchase Order employed WET TECH Energy, Inc. to inspect and report thereon on damages caused by Hurricane Rita to any of the Navigation Lights and support structures of the Black Bayou Project that were in place as appurtenant parts of the various structure features of the Project. The cost of the inspection/report was $2,000.00.

The damages reported were as follows:
(1)The Black Bayou CutOff Channel west Light needed a new battery box and the replacement of two batteries. The east Light of this site did not need was o.k. and needed no repair.
(2)The Block's Creek Structure Lights and supports did not need needed no repair work.

(3)The Burton Canal Structure Light experienced major damage and the entire Light Assembly, Solar Cell, and battery system needed to be replaced.

Later, during May 2006, the damages reported above were all corrected on each respective Structure of the Project by WET TECH Energy, Inc. by a separate Purchase Order for Hurricane Rita Repairs for a total of $3,842.00. The sum of the costs for the Inspection/Report and thence the repair efforts was $5,842.00. This entire sum was reimbursed by FEMA for reason of the storm damage.

July 2005 - SRT Gate modification and culvert installation: In the spring of 2005, it was determined that water was "stacking up" on the southeast corner of the project area. In order to correct the situation, the cross sectional area of the SRT Gate was increased by attaching a flap to the railing. Also, two 30" flapgated culverts on the southern boundary of the project will relieve excess waters. A Notice to Proceed dated July 20, 2005 was issued to Duphil, Inc. of Orange, Tx. Construction was accepted as complete on January 4, 2006 at a total construction cost of $84,976.87. Engineering & design, construction oversight, and as-built drawings were provided by C. H. Fenstermaker & Associates at a total cost of $39,856.77.

Navigational Light Maintenance: Automatic Power, Inc. inspects, and if needed, repairs the navigational aid lights at Burton Canal, Block's Creek, and Black Bayou Cut-Off Canal on a quarterly basis. Costs incurred include:

Burton Canal (1/30/07)	$525.00
Burton Canal (2/12/07)	$1,550.00
Black Bayou Cutoff (1/30/07)	$525.00
Blocks Creek (1/30/07)	$525.00
Burton Canal (4/24/07)	$525.00
Burton Canal (4/24/07)	$525.00
Black Bayou Cutoff (4/24/07)	$75.00
Blocks Creek (1/30/07)	$525.00
Burton Canal (8/22/07)	$525.00
Burton Canal (8/22/07)	$525.00
Black Bayou Cutoff (8/22/07)	$75.00
Blocks Creek (8/22/07)	$525.00
Burton Canal (11/7/07)	$525.00
Burton Canal (11/7/07)	$525.00
Black Bayou Cutoff	
Blocks Creek (11/7/07)	$525.00
TOTAL	**$8,000.00**

III. Operation Activity

a. Operation Plan

There are no water control structures associated with this project that require manual operation, therefore no Structural Operation Plan is required.

b. Actual Operations

There are no active structural operations associated with this project.

IV. Monitoring Activity

Pursuant to a CWPPRA Task Force decision on August 14, 2003 to adopt the Coastwide Reference Monitoring System-*Wetlands* (CRMS) for CWPPRA, updates were made to the CS-27 Monitoring Plan to merge it with CRMS and provide more useful information for modeling efforts and future project planning while maintaining the monitoring mandates of the Breaux Act. Recommended changes in monitoring stations and the schedule of data collection are listed under individual monitoring elements. In this report, six CRMS sites (4 inside and 2 outside the project) are merged into the monitoring activity.

a. Monitoring Goals

The objectives of the Black Bayou Hydrologic Restoration project are:

1. Increase freshwater retention that reduces salt water intrusion in the project area.
2. Establish emergent wetland vegetation in shallow open water areas.
3. Protect emergent marsh in project area by reducing erosion along GIWW.
4. Increase occurrence of SAV in project area.

The following goals will contribute to the evaluation of the above objectives:

1. Reduce mean salinities within the project area.
2. Increase the land to water ratio within the project area.
3. Reduce mean erosion rate of protected shoreline along GIWW.
4. Increase SAV in interior ponds within the project area.

b. Monitoring Elements

Aerial Photography

Near-vertical color-infrared aerial photography (1:24,000 scale) was used to measure vegetated and non-vegetated areas for the project and reference areas. The photography was obtained in November 2000 prior to project construction and postconstruction in November 2004. The original photography was checked for flight accuracy, color correctness, and clarity and was subsequently archived. Aerial photography was scanned, mosaicked, and georectified by U.S. Geological Survey at the National Wetlands Research Center (USGS/NWRC) personnel according to standard operating procedures to develop land:water analyses (Steyer et al. 1995, revised 2000). Differences in percent land over time within the project and between the project and reference areas are calculated from the land:water analyses. Aerial photography is scheduled to be obtained in 2009 and 2016.

Salinity

Salinity data from both discrete (YSI 30) and continuous recorder (sonde) stations were monitored to characterize the spatial variation in salinity throughout the project area and to determine if salinity was reduced in the project area. Discrete salinities were monitored: (A)

monthly from June 1999 (preconstruction) through March 2004 (post construction) at designated stations throughout the project and reference area and (B) during submerged aquatic vegetation surveys in the fall of 1999, 2003, 2005, and 2007. In addition, discrete surface water salinity data were collected inside and outside of project structures during the engineering inspection in November 2007.

Hourly salinity and water levels (ft, NAVD88) were monitored with a continuous recorder in the impoundment side of the SRT gate (station CS27-25) from May 2000 to present. Salinity data collection from the discrete stations and a continuous recorder (station CS27-22) was discontinued in March 2004 to be replaced by CRMS-*Wetlands* stations. Unfortunately, implementation of CRMS stations was delayed by Hurricane Rita (disturbance, access, repairs, and clean-up) and other unforeseen delays. CRMS stations have since been installed within the project area (CRMS0658 replaced CS27-25) and south of the project area (Table 1; figure 2). Continuous recorders at were not implemented within the project area until February 2008 and are not included in this report.

Table 1. CRMS sites and data collection start dates used to monitor CS-27. Data was deemed Not Applicable (N/A) if it was collected after 2007 for Continuous Hydrology and was not collected or unusable for Soil Properties.

CRMS Site	Location	Continuous Hydrology	Vegetation	Porewater Salinity	Soil Properties
0658	Proj - East	N/A	Sept 2007	Sept 2007	Feb 2008
0662	Proj - West	N/A	Sept 2007	---	N/A
0663	Proj - West	N/A	Sept 2007	---	Feb 2008
2166	Proj - West	N/A	Sept 2007	Sept 2007	N/A
0665	Ref - South	Dec 2007	Sept 2006	Sept 2006	N/A
0660	Ref - South	Apr 2006	Sept 2006	---	May 2006
2189	Ref - South	Mar 2007	Sept 2006	---	N/A

Vegetation Plantings

Schoenoplectus californicus (bullwhip) plantings were installed in 2002 and 2003 to establish emergent wetland vegetation in shallow open water areas within the project area. These plantings took place in two phases; Phase I was completed in May 2002 in the east side of the project area (~ 7 acres), and Phase II was completed in May 2003 in the west side of the project (~ 6 acres). The percent survival of vegetative plantings in phase I was determined after one growing season post construction (2003) in approximately 3% of the vegetation plantings (53 sampling plots). Each sampling plot consisted of 16 plantings from one row with the sampling location determined by a random numbers table and marked with a labeled post. Planting survival was determined as a percentage of the number of live plants to the number initially planted (percent survival = (no. live plants/no. planted) × 100) (Mendelssohn and Hester 1988; Mendelssohn et al. 1991). No further monitoring of the plantings is scheduled.

Shoreline Change

To document the effectiveness of the foreshore rock dike to reduce erosion and protect the emergent vegetation in the breached areas of impoundment along the GIWW, we conducted shoreline surveys using a differentially corrected Global Positioning System (dGPS) to map the vegetated edge (Figure 1). The dGPS system used is considered to have sub-meter accuracy. Surveys were conducted 1 2/3 years preconstruction in March 2000, immediately (4 months) post-construction in March 2002, and 2 3/4 years post-construction in August 2004. Analyses of shoreline change was performed by digitally overlaying mapping clean line features for each dataset in a Geographic Information System (GIS, ArcGIS). Polygon features were then created for all areas within closed intersections of the two polyline datasets. The generated polygon features represent the total change in land area as defined by the difference in shoreline position during the sampling interval. The total area for all polygons between the line features was calculated and each polygon feature was defined as gain or loss. The total land area in acres of gain and loss was then calculated. The reference area shoreline was compromised because of another rock dike construction during the time between the 2000 and 2002 GPS surveys and, therefore, no meaningful comparisons can be made between project and reference; consequently, we evaluated shoreline change over time. The data is presented in two increments, pre- to immediately post-construction (2000-2002) and post construction (2002-2004). No additional shoreline surveys are scheduled.

Submersed Aquatic Vegetation (SAV)

To document changes in the occurrence of SAV, project areas (1-6) and a reference area were monitored over time using the rake method (Chabreck and Hoffpauir 1962) (Figure 3). Three transects oriented northeast to southwest were established across open water (ponds or impoundments) in each area. Submersed aquatic vegetation was sampled repeatedly along each transect by dragging a garden rake on the pond bottom for one second. The presence or absence of vegetation was recorded for each sample to determine the percent occurrence on a transect (% occurrence = (number of samples with SAV/number of samples) × 100). When vegetation was present, the species present was recorded in order to determine the frequencies of individual species (Nyman and Chabreck 1996). SAV was monitored before construction in fall 1999 and after construction in fall 2003, 2005, and 2007. Monitoring will continue in fall of 2010, 2012, 2014, and 2017.

CRMS-*Wetlands* (CRMS) Supplemental

In addition to project specific monitoring elements, other data types are collected at CRMS sites which can be used as supporting or contextual information (Figure 2). Data types collected at CRMS sites include hydrologic from continuous recorder (mentioned above), vegetative, physical soil characteristics, discrete pore water, surface elevation, and land:water analysis of 1 km^2 area encompassing the station. For this report, data from four sites within the project area are compared to data from three sites outside the project area in a traditional project versus reference manner. In the future, data collected from the CRMS network over a sufficient amount of time to develop valid trends will be used to develop integrated data indices (hydrology, plant productivity, and soil surface elevation change) at different spatial scales (local, basin, coastal) to which we can compare project performance.

Discrete pore-water from the soil salinity at 10 and 30 cm was collected at five of the vegetation plots during vegetation sampling. Pore water was extracted with a sipper tube assembly (rigid aquarium tubing, flexible hose, and syringe), and salinity was measured using a hand held salinity meter (YSI 30 Salinity, Conductivity, Temperature Meter). Two sites inside and one site outside the project were selected to compare specific locations for this report (Table 1; Figure 2).

Emergent vegetation parameters will be evaluated at each CRMS site using techniques described in Steyer et al. (1995) to describe species composition, richness, and relative abundance; in addition, overall percent cover and height of the dominant species will be monitored. Annually at each site, data will be collected and averaged from ten, 4-m^2 sample plots randomly established along a 282.8 m transect that crosses diagonally through a 200-m × 200-m vegetation plot in middle of the CRMS site. The percent cover of the plot and of each species was fed into a floristic quality index based on the marsh type the data was collected. Floristic Quality Indices (FQIs) have been developed for several regions to determine the quality of a wetland based on its species composition (Cohen et al., 2004; Bourbaghs et al., 2006). This FQI was developed by Jenneke Visser and an expert panel on Louisiana coastal vegetation as part of CRMS analytical working group in 2007. The panel provided an agreed upon score (Coefficient of Conservatism or CC Score) from 0 to 10 for each species in a list of ~500 plant species occurring in Louisiana's coastal wetlands (Table 2). CC scores are weighted by percent vegetative cover and summed to determine the FQI for the CRMS site. CRMS sites inside and outside the project area were used for this report (Table 1, Figure 2).

Table 2. Coefficient of Conservatism (CC) scores of different plant species used to develop of a Floristic Quality Index.

CC Score	General Description	Coastal Louisiana Description
0	Alien taxa or native invasive species	Invasive or non-native plants
1-3	Wide spread taxa found in sites with different levels of disturbance	Opportunistic plants of disturbed areas
4-6	Taxa that display fidelity to a community but can tolerate moderate disturbance	Occur primarily in less vigorous coastal wetland communities
7-8	Taxa that are typical of communities which have sustained only minor disturbance	Common plants in vigorous coastal wetland communities
9-10	Taxa that exhibit a high degree of fidelity to a narrow set of ecological conditions	Dominant plants in vigorous coastal wetland communities

Soil cores were collected to describe soil properties (bulk density and percent organic matter). Three, 4" (10.16-cm) diameter cores were collected to a depth of 24 cm and divided into 6, 4-cm sections at each site. The soil was processed by the Department of Agronomy and Environmental Management at Louisiana State University. Cores were collected at two sites inside the project area, and suitable cores (quality or same marsh type) were collected from 1 site outside the project area.

Soil surface elevation change utilizing a combination of sediment elevation tables (RSET) and vertical accretion from feldspar horizon markers will be measured twice per year at each site. This data will be used to describe general components of elevation change and establish accretion/subsidence rates. The RSET will be surveyed to a known elevation datum (ft, NAVD 88) so it can be directly compared to other elevation variables such as water level. Currently, data has not been collect over enough time to calculate viable rates; therefore, elevation change is not included in this report.

Aerial photography (color infrared, CIR) of each 1 km^2 CRMS site and satellite imagery (Landsat Thematic Mapper, TM) of the entire hydrologic basin will be acquired every three years beginning in 2005. In addition, the CS-27 project area will be sub sampled from the basin-level, satellite imagery. The photography and satellite imagery will be classified by land and water to track changes over time. The baseline data has been collected for this data series; however, this information will not be reported until two periods of data have been analyzed in order to evaluate change.

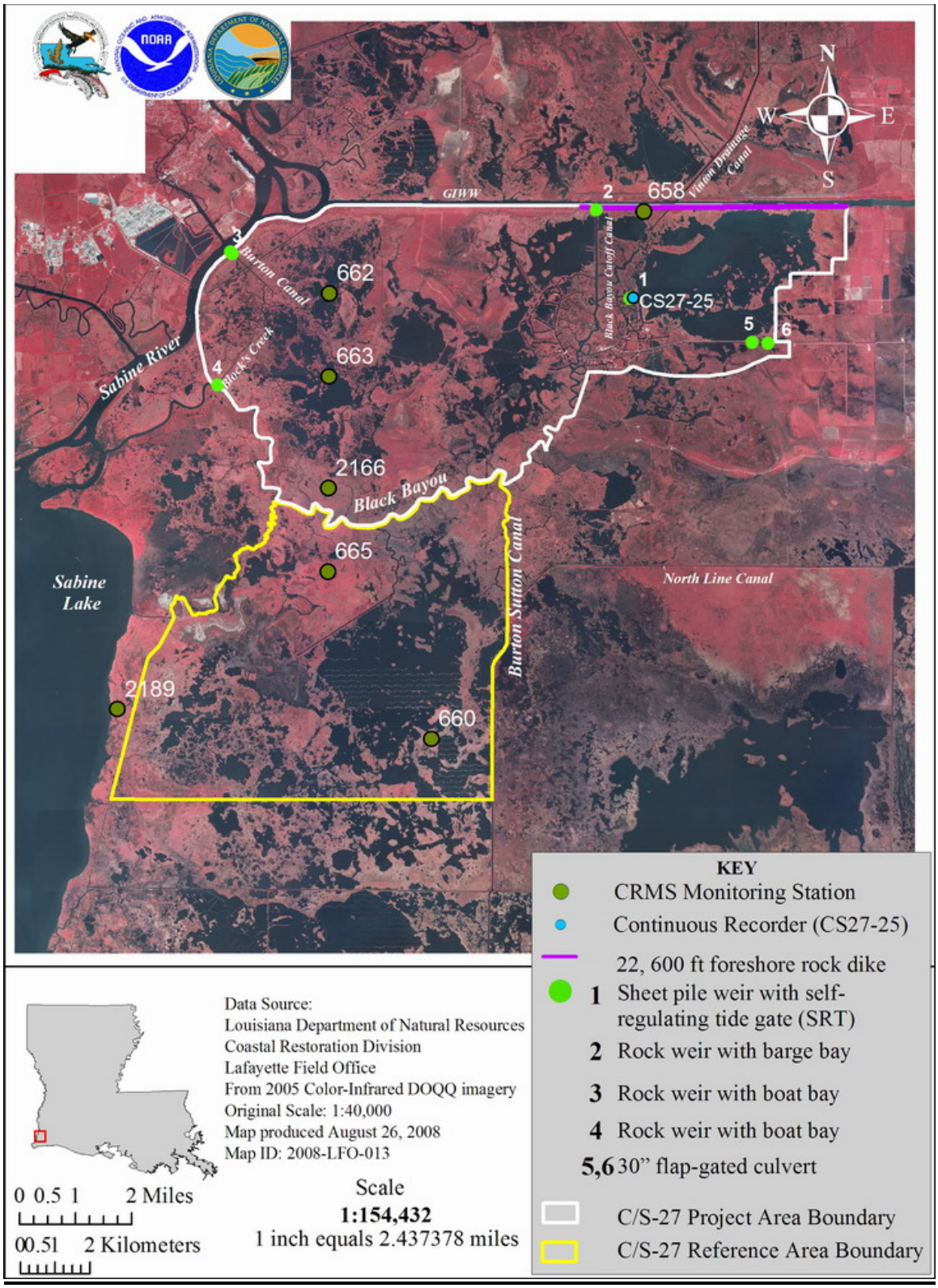


Figure 2. CS-27 continuous recorder station and CRMS-*Wetland* sites located within and in the vicinity of project area.

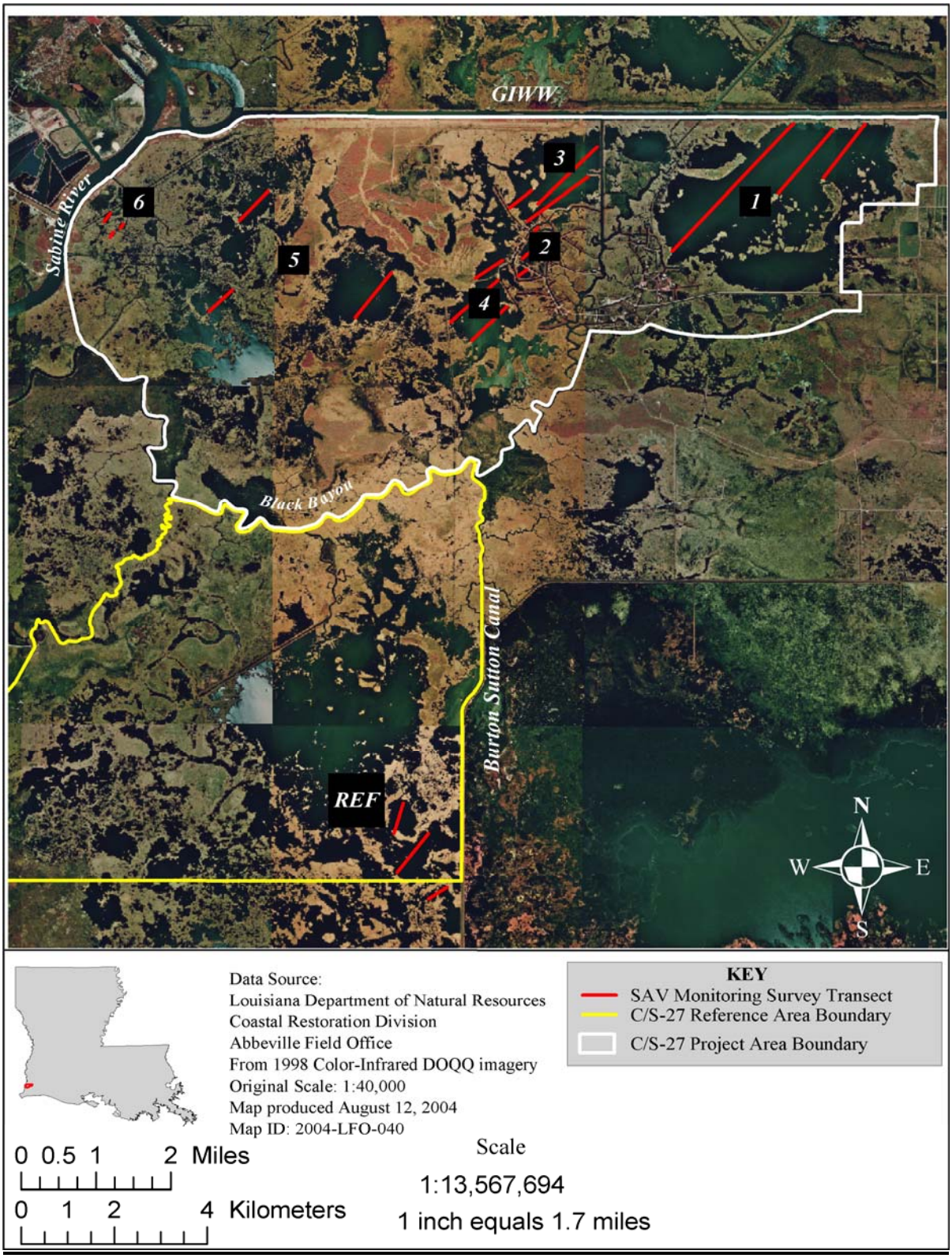


Figure 3. Location of SAV sampling in the project and reference areas.

IV. Monitoring Activity (continued)

c. Preliminary Monitoring Results and Discussion

Aerial Photography

Land:water analyses from aerial photography acquired before construction in November 2000 and after construction in November 2004 was performed by the U.S. Geological Survey (Figure 4 a and b). Based on calculations of the acreages provided in the maps, the project area increased land cover by 0.55% from 2000 to 2004 (1 year pre-construction to 3 years post-construction). During this same time, the reference area increased land cover by 1.97%, overall, 1.42% greater than the project area. Unfortunately, full interpretation of this land change data for project effectiveness is limited by the small percentages that are less than the acceptable error for comparing time intervals (Pers. Comm. John Barras). Trends described by future data collections (2009 and 2016) will be more useful in evaluating project effects.

Salinity

Discrete data from 2003 and 2004 revealed that salinities across the area are very similar ranging from 0.5 to 3.0 ppt over time. Salinities were generally the least in the impoundment east of the Black Bayou Cut-off Canal (BBCC) followed by interior project areas influenced by the BBCC, Block Creek, and Burton Canal structures. Salinities were typically higher along the perimeters of the project areas and the southern reference area with the highest salinity in the GIWW north of the impoundment. Although this monthly discrete data collection was discontinued in 2004, discrete salinity samples were collected throughout the northern portion of the project area and in the southeastern corner of the reference area during autumn SAV surveys (Figures 3 and 5). Salinity widely oscillated among all areas since 1999 between <1 to >10 ppt with all sampling periods being different ($F_{3,3} = 464.29$, $p < 0.0001$). Salinity was typically higher in the reference than the project transects, and, within the project area, salinity is typically higher in area 1 (the impoundment) and least in the interior areas (4 and 5) ($F_{6,6} = 27.04$, $p < 0.0001$). Areas on the perimeter of the project area (1 and 6) have been highly variable relative to other areas within the sampling periods ($F_{18,18} = 7.06$, $p < 0.0001$). During the 2007 engineer's inspection, a salinity survey conducted inside and outside the project structures supported the finding that the project is holding a fresher water head as typically lower salinity water was flowing out of the project area (Table 3). The areas most influence by the GIWW (BBCC and the Impoundment) were 3 to 4 ppt lower than the GIWW, respectively.

Table 3. Discrete salinity measurements collected at CS-27 structures on 27 November 2007.

Structure	Salinity (ppt)		
	Inside Project	Outside Project	Difference (In-Out)
Blocks Creek at Black Bayou	4.8	5.6	-1.2
Burton Canal at Sabine River	4.2	4.3	-0.1
Black Bayou Cutoff Canal (CC) at GIWW	4.2	4.0	+0.2
Impoundment SRT to Black Bayou CC	3.3	3.6	-0.3
GIWW Rock Dike north of impoundment	---	7.5	

Continuous salinity and water level data within the northeast portion of the project area (mostly influenced by the BBCC structure and foreshore dike along the GIWW) was monitored from 2000 to 2004 inside (Station CS27-25) and outside (CS27-22) of the impoundment controlled by the self-regulating tide gate. Salinity and water levels were typically higher but less variable inside the impoundment (Figures 6 a and b). Station CS27-22 was abandoned in March 2004 to be replaced by CRMS station 0658 which was not implemented until after 2007. Station CS27-25 remained in place through 2007 (figures 7 a-c), surviving Hurricane Rita in September 2005. The hurricane's approach pulled fresher water into the impoundment raising the water level ~ 3 ft and decreasing salinity by 1.25 ppt. During Rita, the water was quickly pushed out as the water level dropped ~ 3.5 ft. The day after Rita passed, salty water piled into the impoundment as the water level rose ~ 3 ft and salinity increased 15.5 ppt over the next 28 hrs after which water level and salinity began to recede. After the initial receding of water level and salinity following Hurricane Rita (~ 1 month), water levels were lower and salinities were higher than typical until mid spring 2006. Coincidentally, the project area experienced less than less normal rainfall (Southern Regional Climate Center 2008) and drought conditions (NOAA 2008) for several months leading up to Hurricane Rita and afterwards through June 2006 (Figure 8). Outflow flaps were added to the SRT gate and culverts were installed in the southeast boarder of the impoundment within this timeframe, as well. Much of the hourly data, especially salinity, in 2007 was lost because of sensor interference caused by siltation of the plugged canal where CS27-25 is located; therefore, monthly, discrete measurements were used as needed.

A sonde at CRMS site 0660 started recording hourly hydrologic data in April 2006 (Table 1, Figure 3). Salinity and water levels at CRMS 0660 were greater than in the impoundment (CS27-25) until late fall 2006 after which they were similar through 2007 (Figure 9). Continuous hydrologic data from CRMS sites within and outside the project area which have come on-line since 2007 will contribute greatly to evaluating the hydrodynamics of the project area in the coming years (Figure 3).

Vegetation Plantings

Schoenoplectus californicus (bullwhip) plantings were installed in the east side (Phase I – 2002) and the west side (Phase II – 2003) of the project area. Monitoring was conducted in September approximately 1 year after Phase I planting. Sample plots had varying survival success. Individual plantings were recorded as alive, absent, or dead. Except for a few, most plants counted as absent or dead were absent. A total of 53 plots containing 848 plants were

sampled. The mean percentage found alive was 68% ranging from 100% to 6% survival. Some plots had robust, healthy plants almost indistinguishable, whereas, other plots had plants with few stems in deteriorated condition (LDNR 2004). Similar observations were noted about the Phase II planting in spring 2008.

Shoreline change

A foreshore rock dike was completed in November of 2001 along the southern shoreline of the GIWW on the western side of the project area between the Black Bayou Cut-off Canal and Gum Cove Ridge. To evaluate the effectiveness of the dike to decrease erosion, shoreline surveys (dGPS) of the breached portion of the GIWW shoreline along northern boundary of the impoundment were conducted before construction in March 2000, soon after the rock dike was constructed in March 2002, and about 3 years after construction in August 2004. Overall, the dike has been successful as this area gained land more than twice as fast during the post construction period than the predominantly preconstruction period (Table 3; Figures 10 a and b). Sediments are trapped and settling in the low energy area behind the dike and forming mud flats which are colonized by vegetation (Figure 11).

Table 3. Net land gain and rates along the GIWW shoreline/northern impoundment boundary protected by the foreshore dike

Time Period	Net Land Gain	Land Gain Rate
2000-2002 (mainly preconstruction)	0.125 acres	0.063 acres/yr
2002-2004 (post construction)	0.317 acres	0.131 acres/yr

Submersed Aquatic Vegetation (SAV)

Submersed aquatic vegetation was sampled in many open water areas throughout the project and reference areas (Figure 3). Overall, SAV coverage has remained high (>50% occurrence) in most of the ponds sampled since pre-construction monitoring in 1999. Differences in SAV occurrence among the areas ($F_{6,6} = 4.57$; $p = 0.0009$) remained consistent as SAV occurrence differed over time ($F_{3,3} = 13.22$; $p < 0.0001$) (Fig. 12). Percent occurrence of SAV is greatest in the areas just west of the BBCC (Areas 2, 3, and 4) and least in the Reference area south of the project area and the impoundment (Area 1) with the other areas hovering in between. Combining all areas, the percent occurrence of SAV has shifted over time from 50-90% from 1999 to 2007 following salinity and disturbances (Figure 12). Coverage of SAV increased about 20 % from 1999 to 2003 (project construction was completed in November 2001). In 2003, we noted a decrease in *Ruppia maritima* (intermediate to brackish water species) and documented *Nymphaea odorata* and *Ottelia alismatoides* (fresher water species) for the first time (Figure 13 b). SAV decreased 45 % from 2003 to 2005, probably as a result of Hurricane Rita which passed in September 2005 (a month before 2005 sampling). Species composition shifted as *Ruppia maritima* increased (Figure 13c). Occurrence of SAV increased about 30% from 2005-2007 to levels between 1999 and 2003 after a couple of years of no construction or large scale disturbances. Species composition also shifted to fresher habitat species with an absence of *Ruppia maritima* (Figure 13 d).

CRMS-*Wetlands* (CRMS) Supplemental

A large reason for hydrologic management in this project is to maintain low salinities in order to allow marsh vegetation to establish and flourish. Pore water collected from the soil at CRMS sites provide a direct measurement of the salinities that the plant roots are exposed to at 10 and 30 cm (~ 4 and 12 inches) below the soil surface. Across sites, pore water was more saline at 30 cm ($F_{1,1} = 22.67$, $p < 0.001$); and, among sites, the sites across Bayou Black from each other, CRMS2166 in the project area and CRMS0665 south of the project area, had similar salinities, where as, the site within the project area between the BBCC and the impoundment along the GIWW (CRMS0658) was less salty than the site south of the project area at 10 cm ($t = 1.88$, $p = 0.0692$) and 30 cm ($t = 2.34$, $p = 0.0258$) below the soil surface (Figure 14).

Floristic Quality Indices (FQI) of CRMS sites were implemented to describe differences in emergent vegetative condition between different areas within the project area and outside the project area. In 2007, the vegetative community in the west side of the project area was healthy for an intermediate marsh type as indicated by an average FQI about 0.75 for the three sites that stretch north to south across the project area (figure 15 a). During the same sampling period, the FQI (~0.7) was slightly lower in the site on the eastern side of the project between the BBCC and impoundment along the GIWW (CRMS0658). This indication of a slightly less healthy, although still healthy, vegetative community was primarily driven by the presence of Roseau cane (*Phragmites australis*) and alligator weed (*Alternanthera philoxeroides*) which are considered undesirable invasive or disturbance species within the context of FQI (Figure 15 b). Reference sites south of the project area had less healthy communities than the project areas. Over 2006 and 2007 the FQI in the reference sites averaged ~0.6 which was attributed to the lower percent cover of species there than in the project sites (Figure 15 c).

Physical soil properties were analyzed from 24 cm (~ 10") deep soil cores collected from three CRMS sites. The soil from the west side of the project area (CRMS0663) and south of the project area (CRMS0660) were typical for an intermediate marsh, low to moderate bulk density (0.06 – 0.15 g/cm^3) and high organic content (> 50%), and soil from both sites were noted upon collection has having many roots throughout core (figure 16). The soil from CRMS0660 was very dark (humic) and denser than soils from CRMS0663. Soil from the site in the eastern side of the project area between the BBCC and impoundment along the GIWW (CRMS0658) was similar to the other sites in the top half of the core, but the bottom half was atypical for soil from an intermediate marsh. The bottom half of the core was very dense (> 0.2 g/cm^3) and had low organic content (< 30%) relative to the other sites (Figure 16), and upon collection the soil was noted to be very silty with few roots. This site is positioned along the GIWW and may be perched on dredged material.

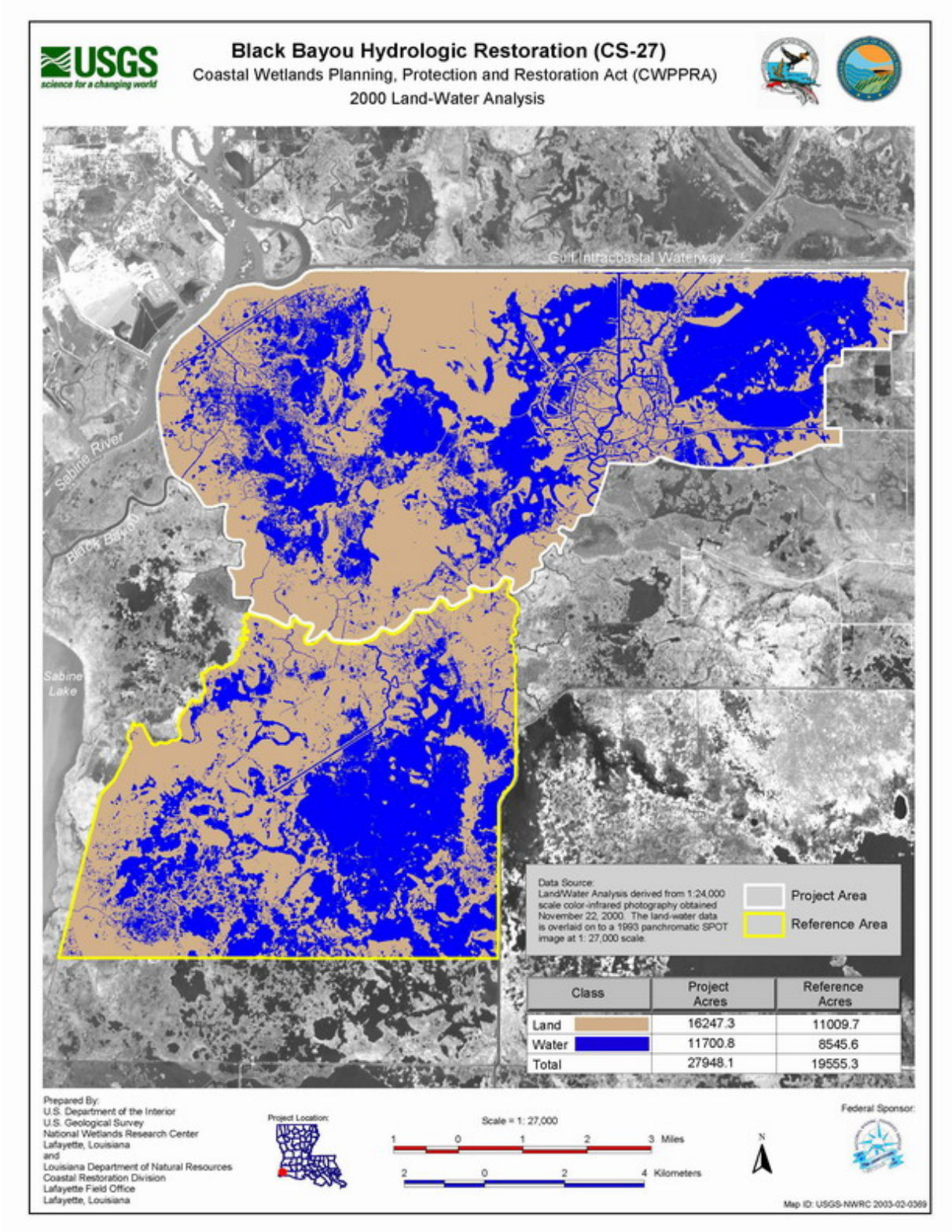


Figure 4 a. Preconstruction land / water analysis of project and reference areas from photography taken November 20, 2000.

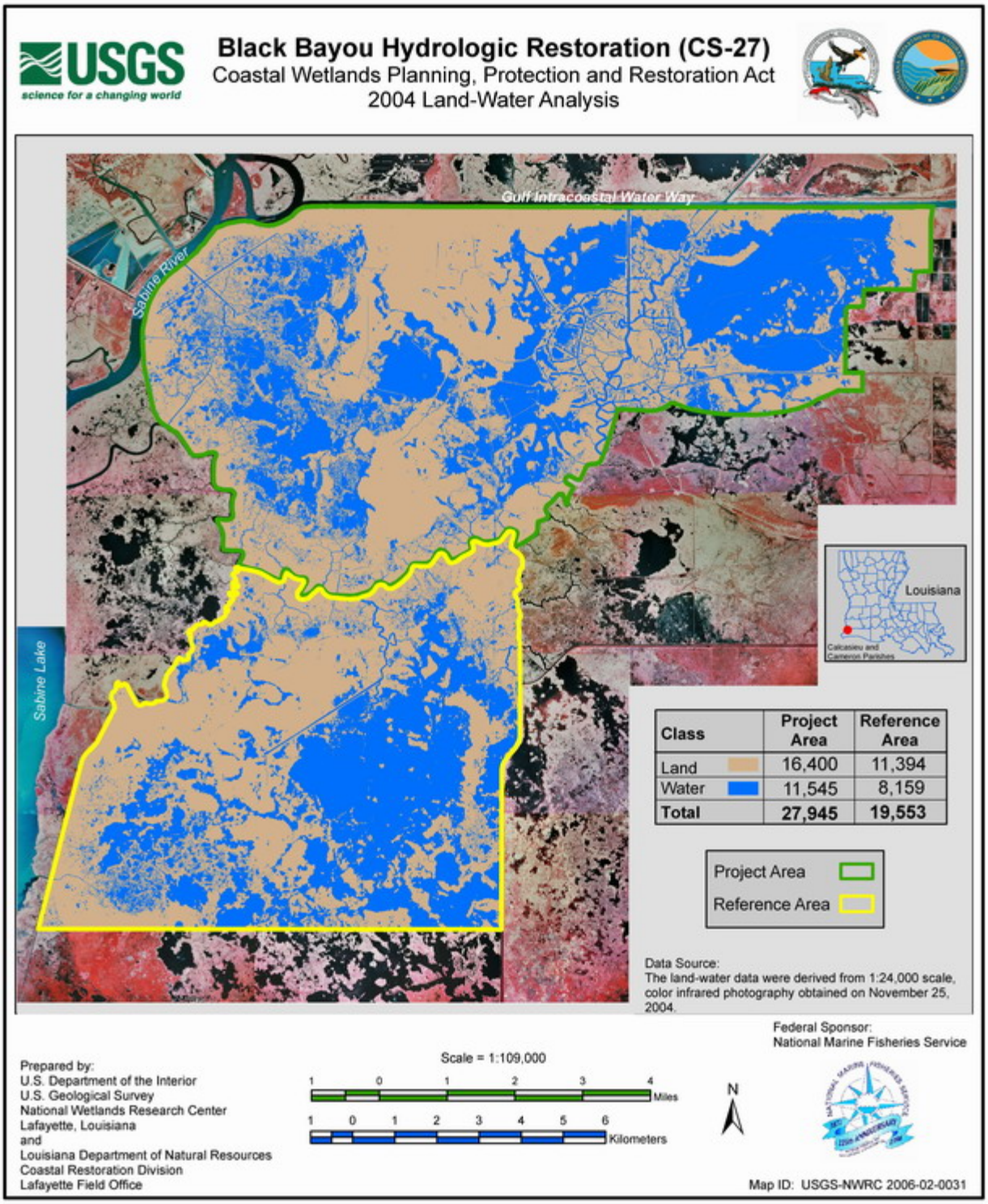


Figure 4 b. Post construction land / water analysis of project and reference areas from photography taken November 25, 2004.

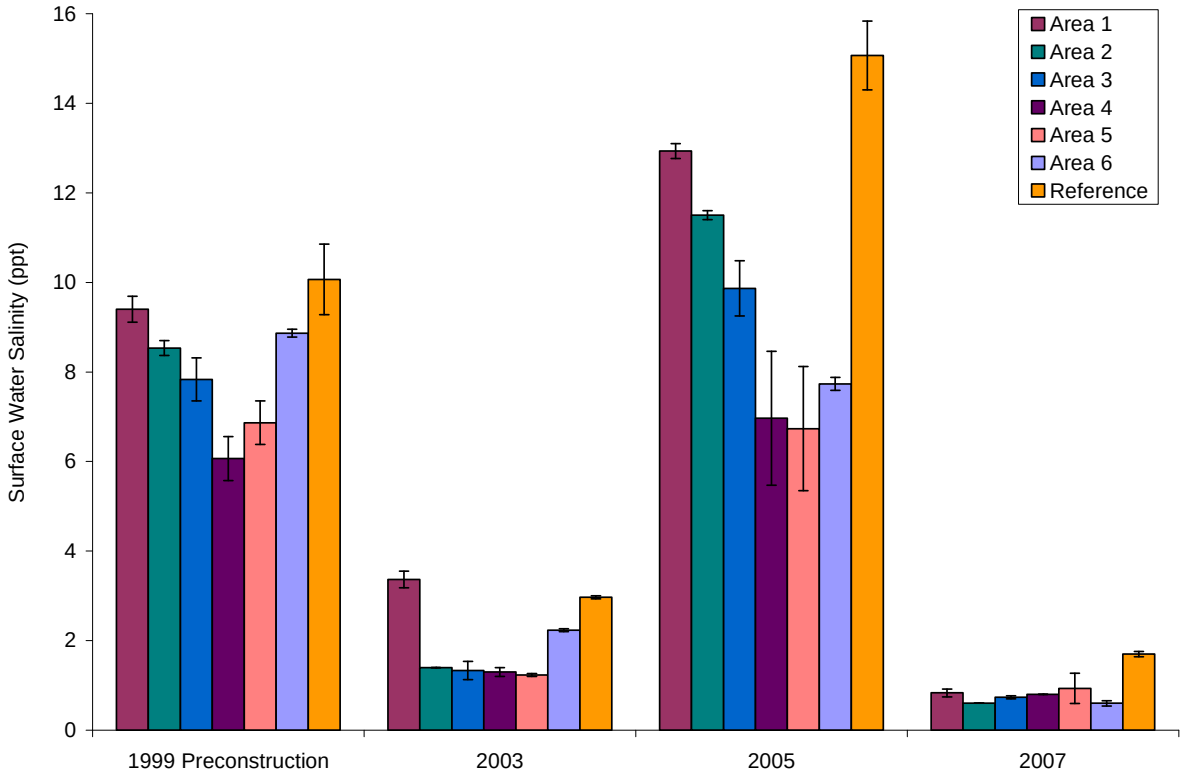


Figure 5. Discrete open water salinity measurements collected by area over time during SAV surveys in late summer/early fall. Values are means and standard errors of three transects (n=3) per area for each year except for area 2 in 2003 (n=1), 2005 (n=2), and 2007 (n=3).

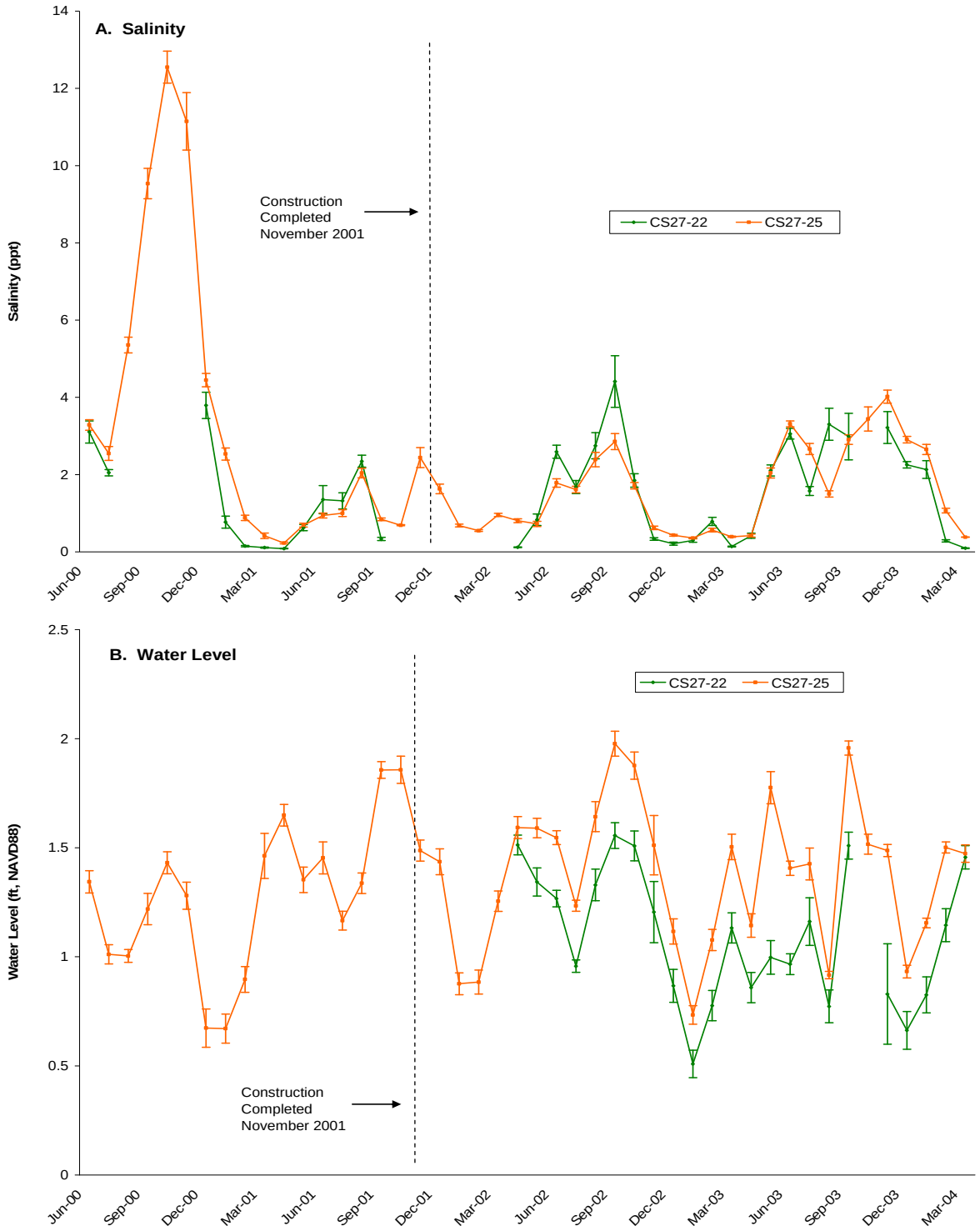


Figure 6. Means and standard errors of continuous (A) salinity and (B) water level data collected at stations CS27-22 (outside impoundment) and CS27-25 (inside impoundment) within the project area from 2000-2004. Construction of structures to control water flow into the project area and to create the impoundment was completed in November 2001.

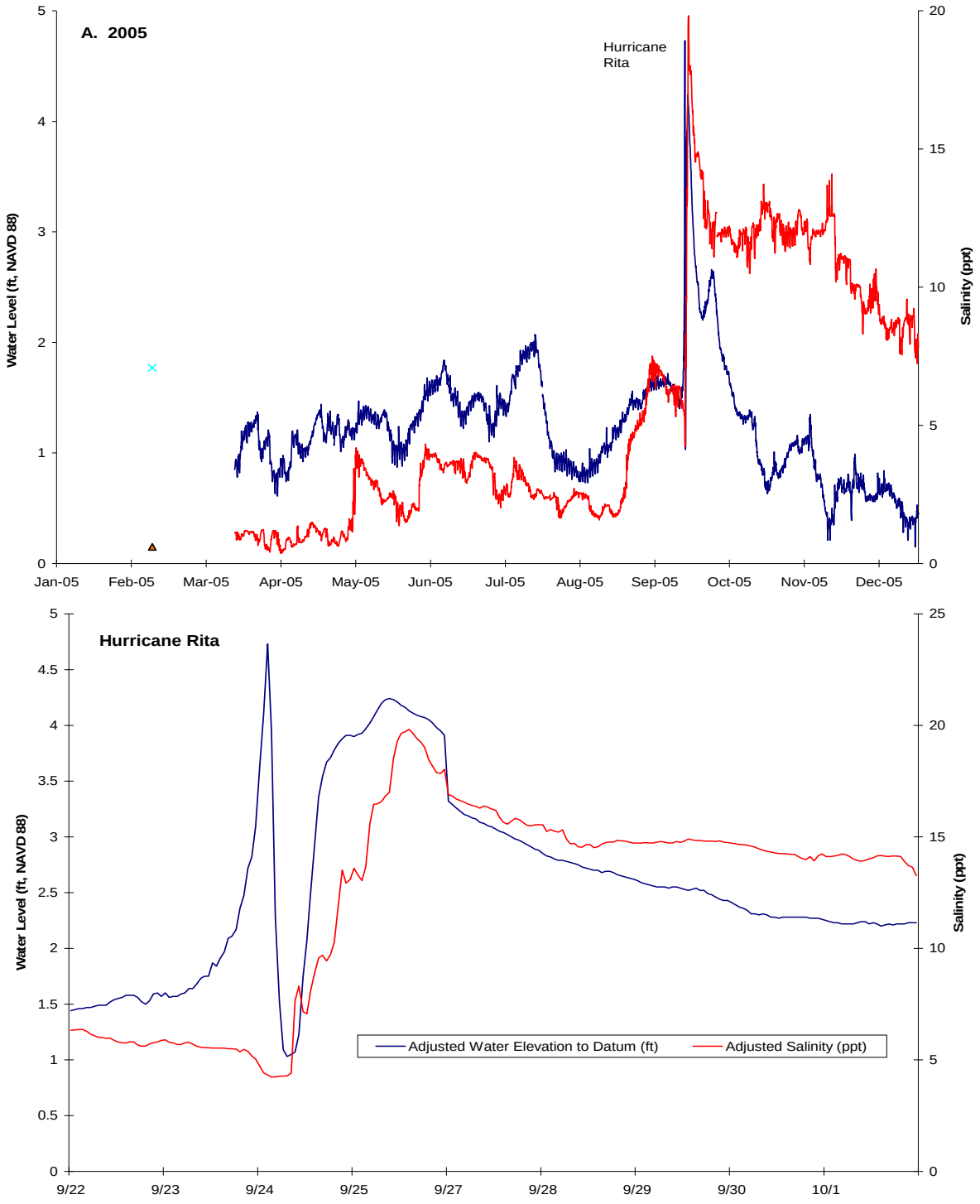


Figure 7 a. Hydrodynamic data collected from station CS27-25 in (A) 2005 and Hurricane Rita (September 22 – October 02, 2005). The lines are hourly data collected from a continuous recorder, and the points are discrete data collected from a staff gauge (water level) and a portable YSI meter (salinity).

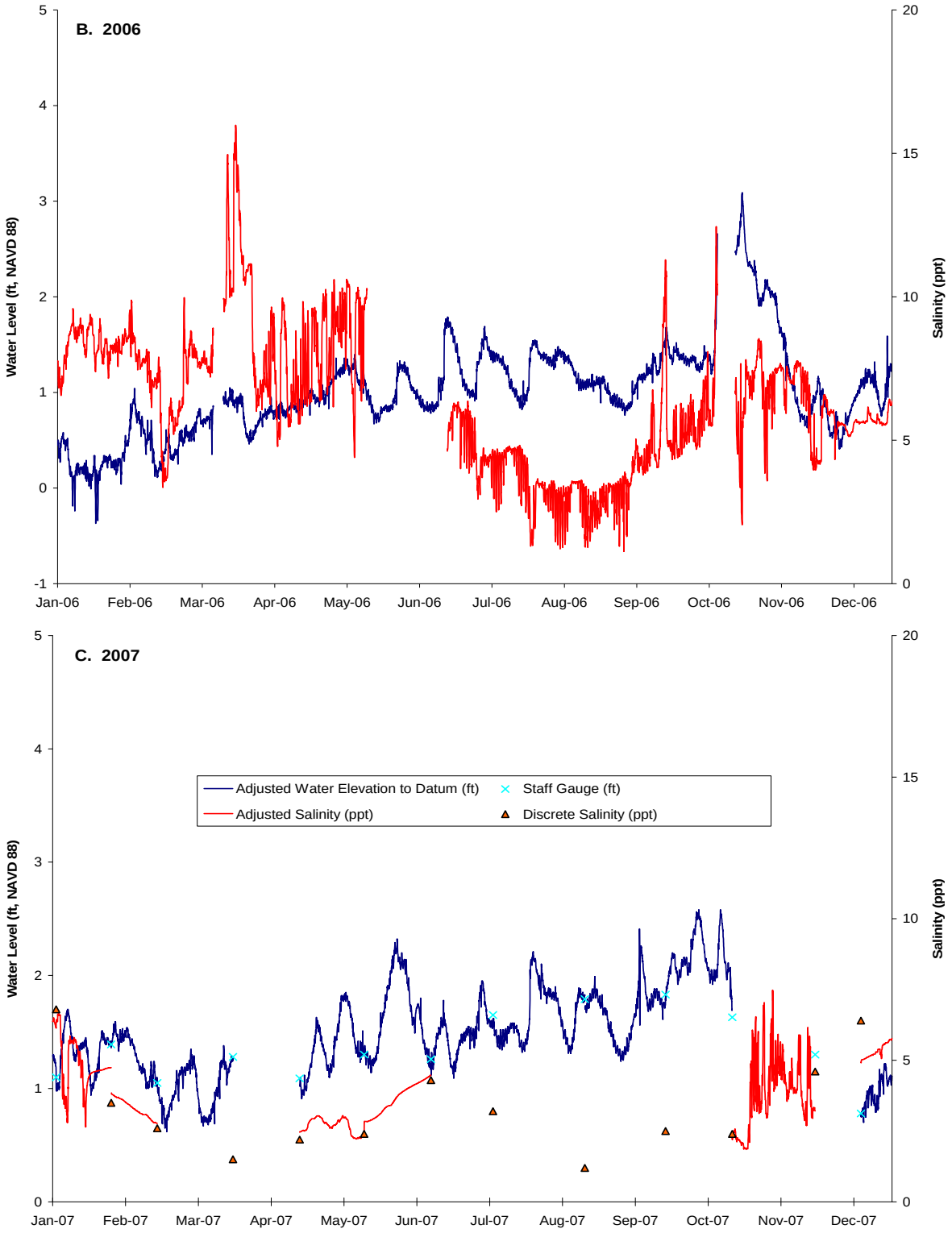


Figure 7 b and c. Hydrodynamic data collected from station CS27-25 in (B) 2006, and (C) 2007. The lines are hourly data collected from a continuous recorder, and the points are discrete data collected from a staff gauge (water level) and a portable YSI meter (salinity).

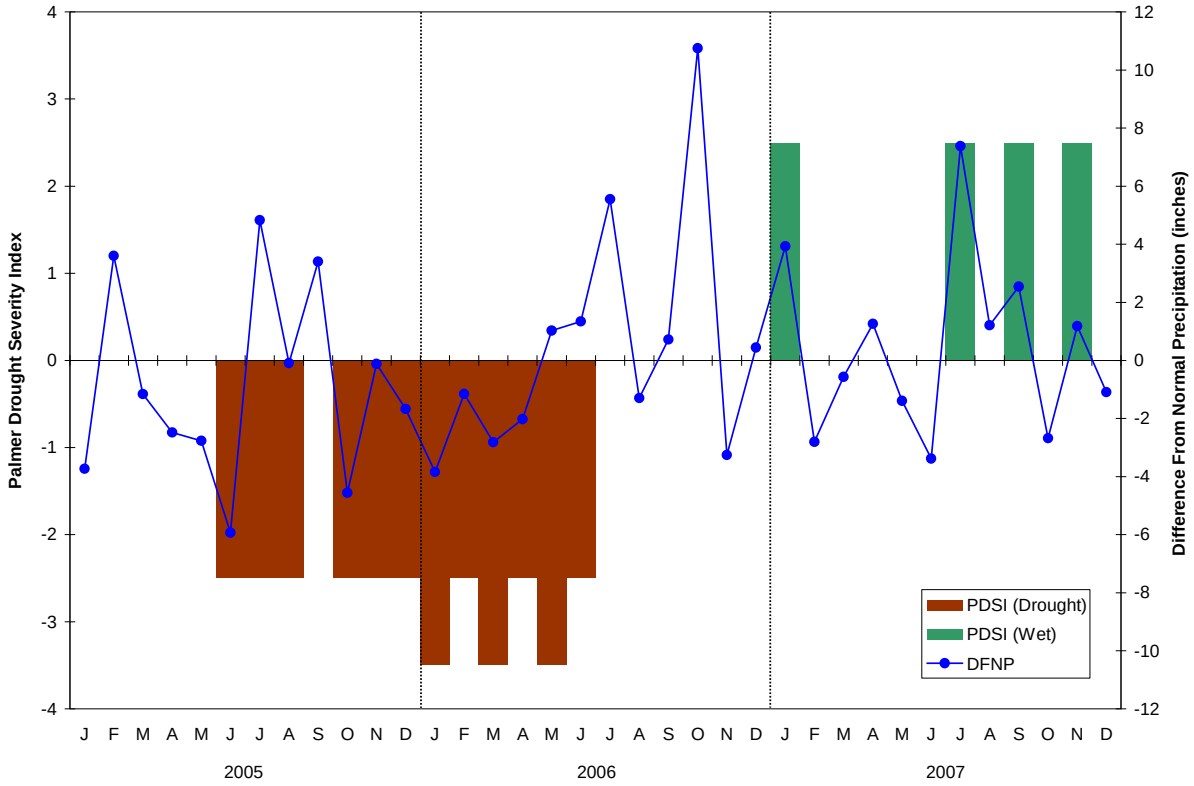


Figure 8. Regional drought (southwest Louisiana) and local precipitation (Orange, TX) patterns from 2005 through 2007 relative to the Black Bayou project area.

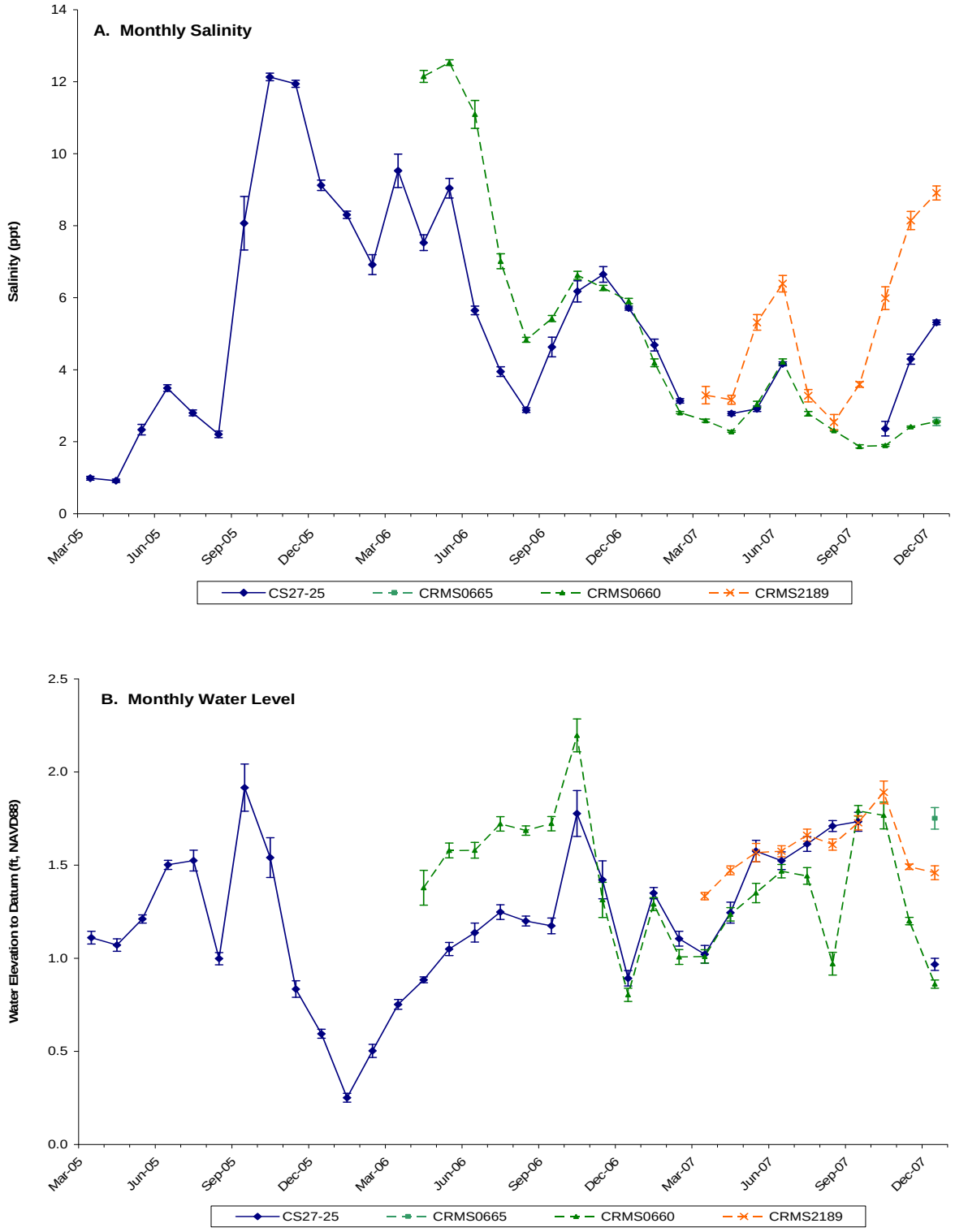


Figure 9. Monthly means and standard errors of (A) salinity and (B) water level data collected from the impoundment in the project area (CS27-25) and CRMS stations south of the project area.

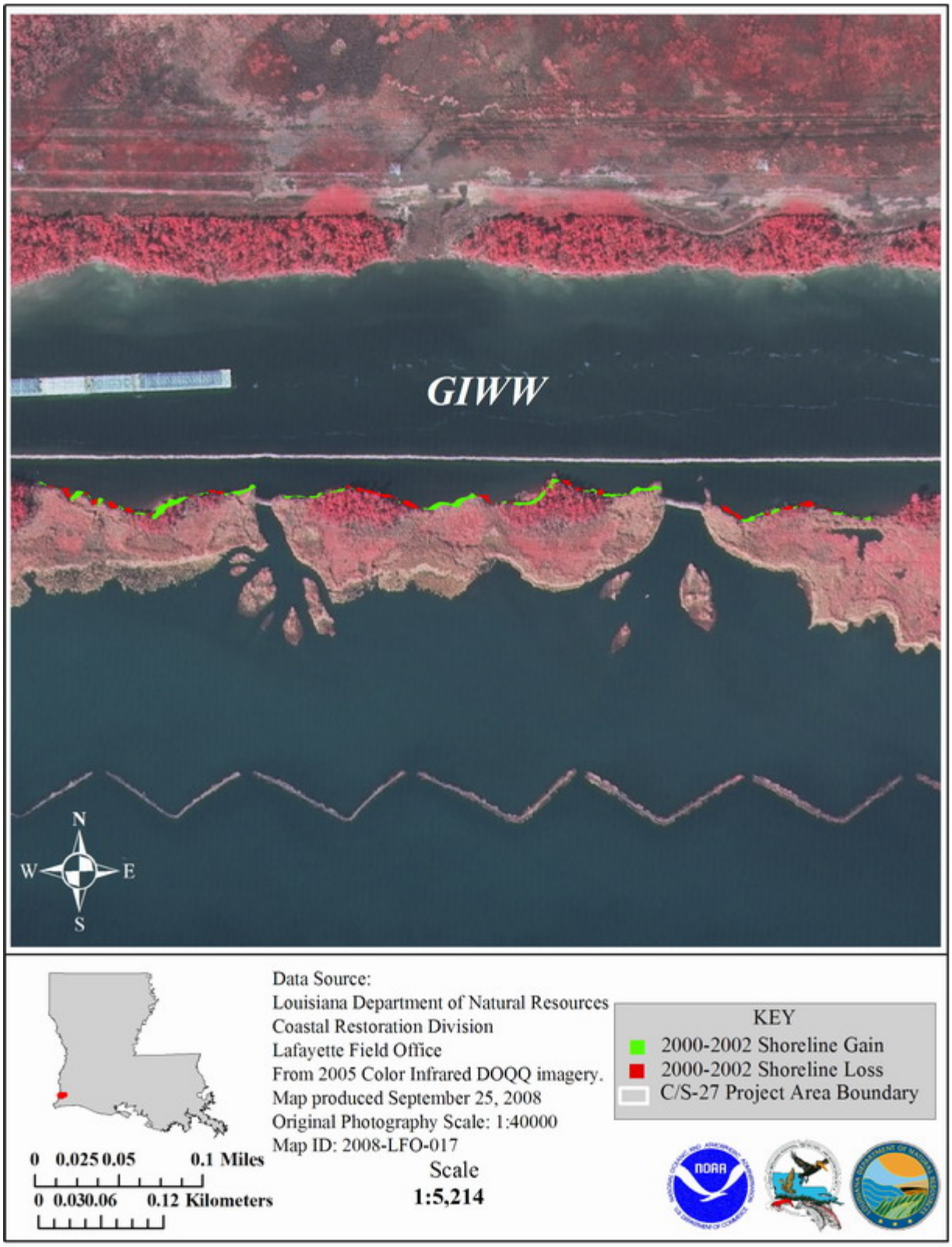


Figure 10 a. Shoreline change from surveys conducted in March 2000 and March 2002.

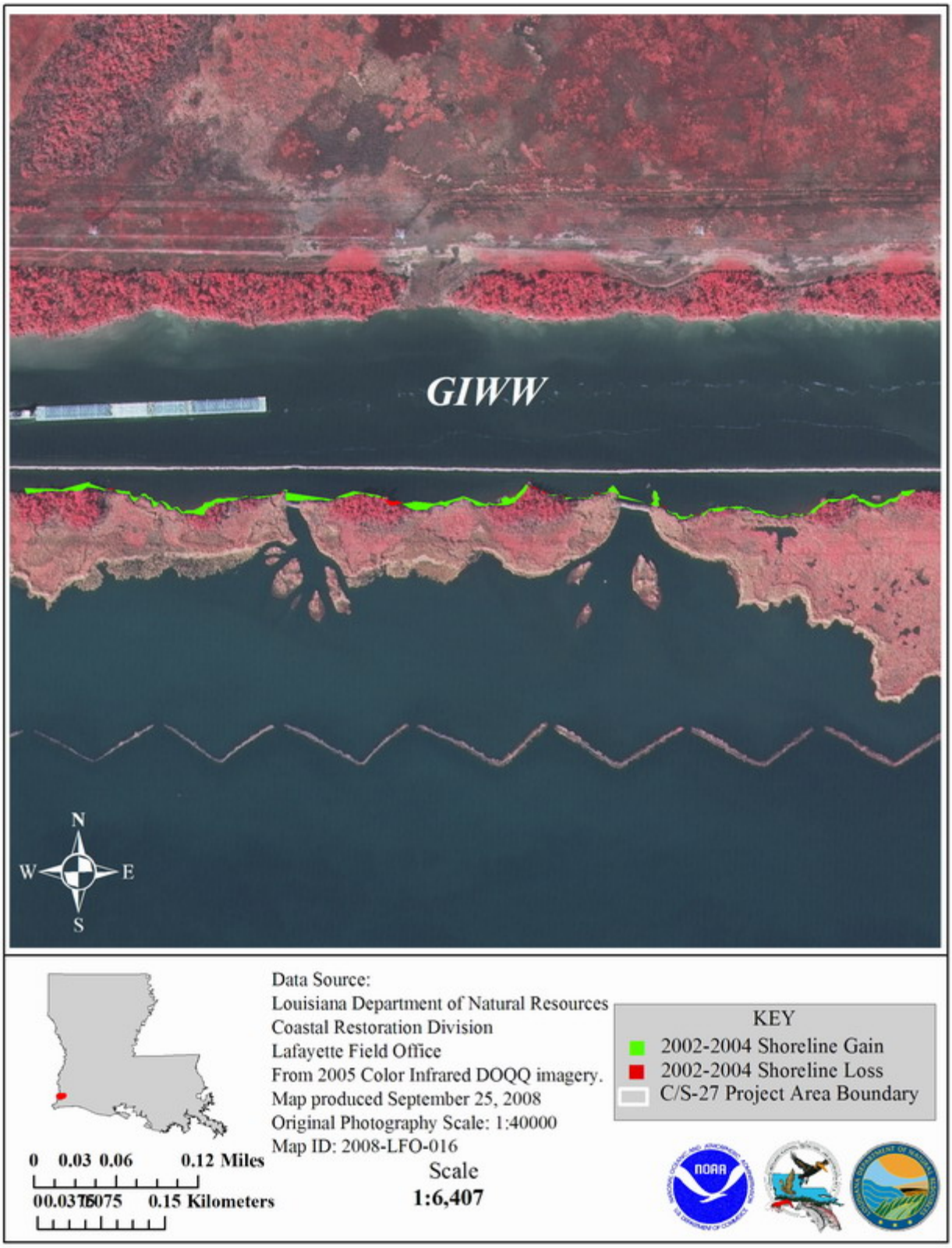


Figure 10 b. Shoreline change from surveys conducted in March 2002 and August 2004.

Figure 11. Sedimentation and vegetative growth between the GIWW rock dike and dredge material levee along the north side of the impoundment.

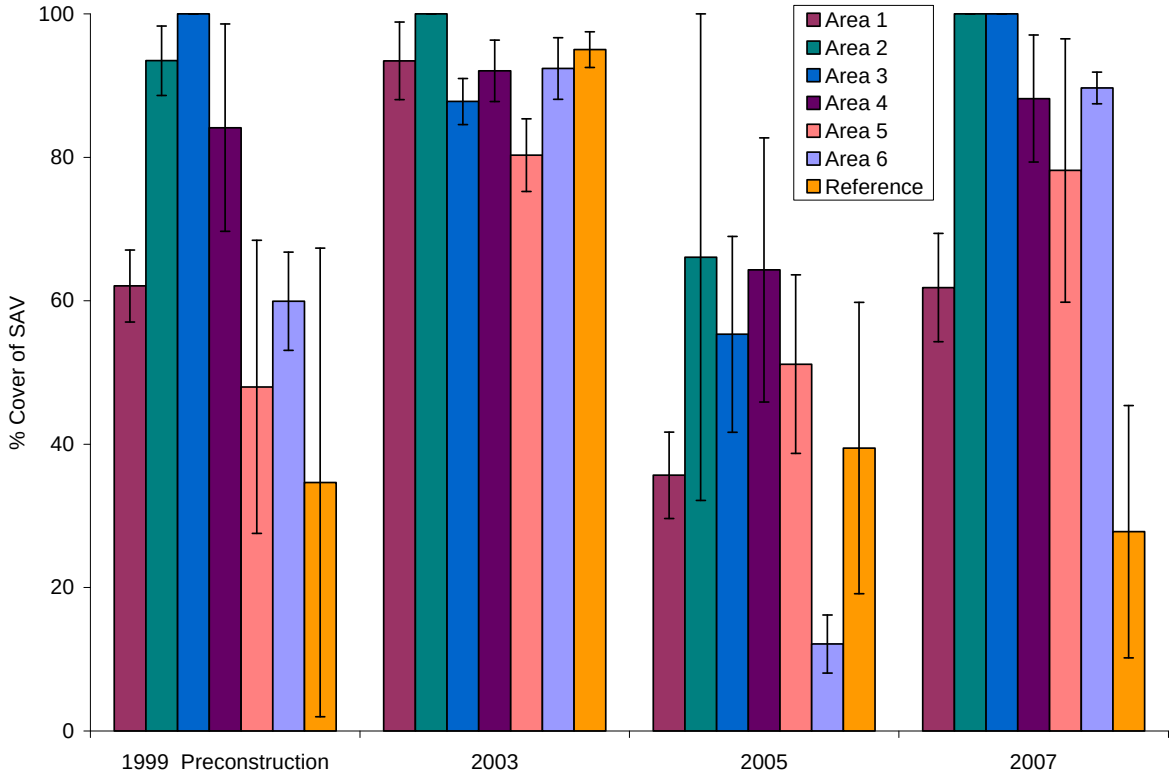
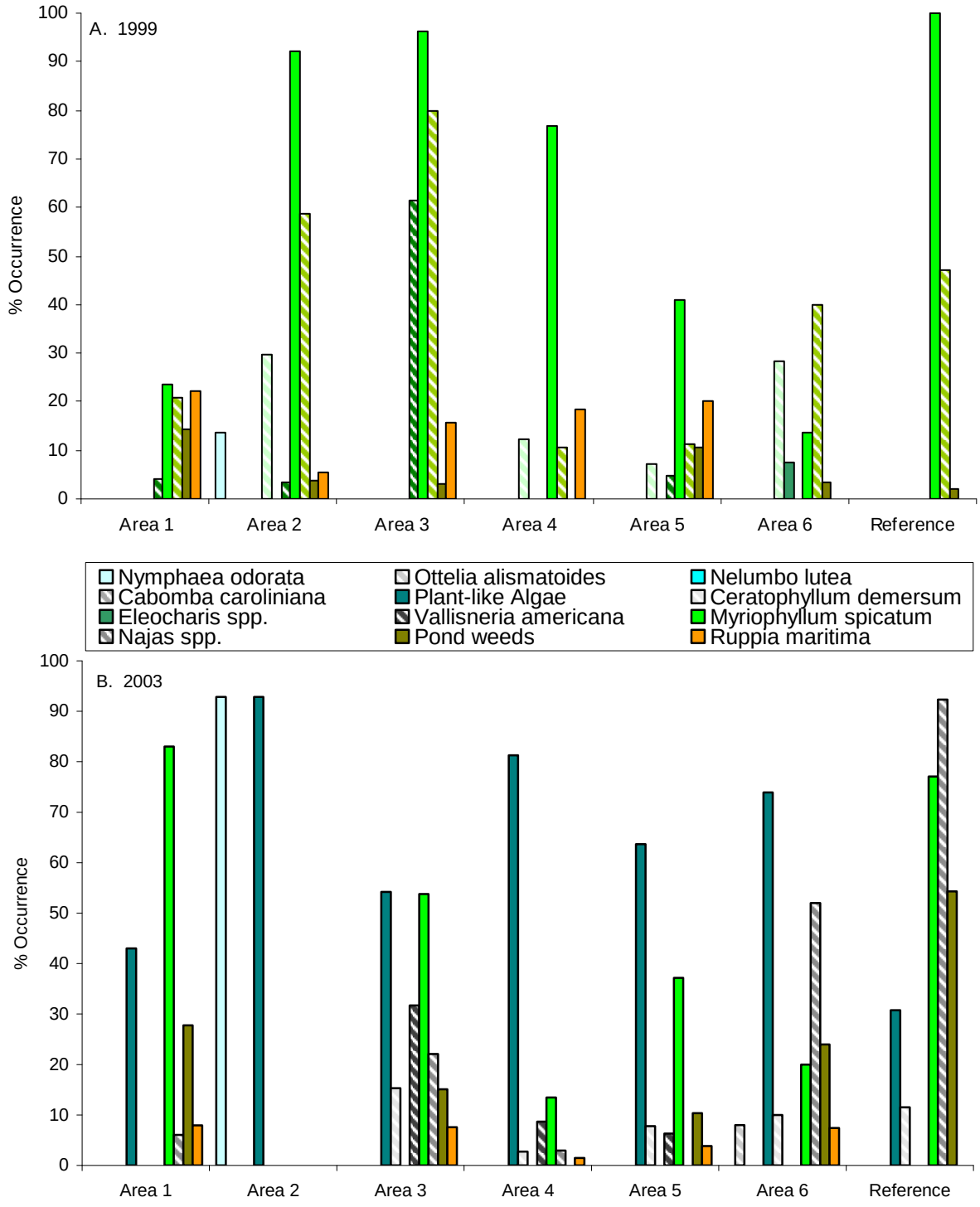
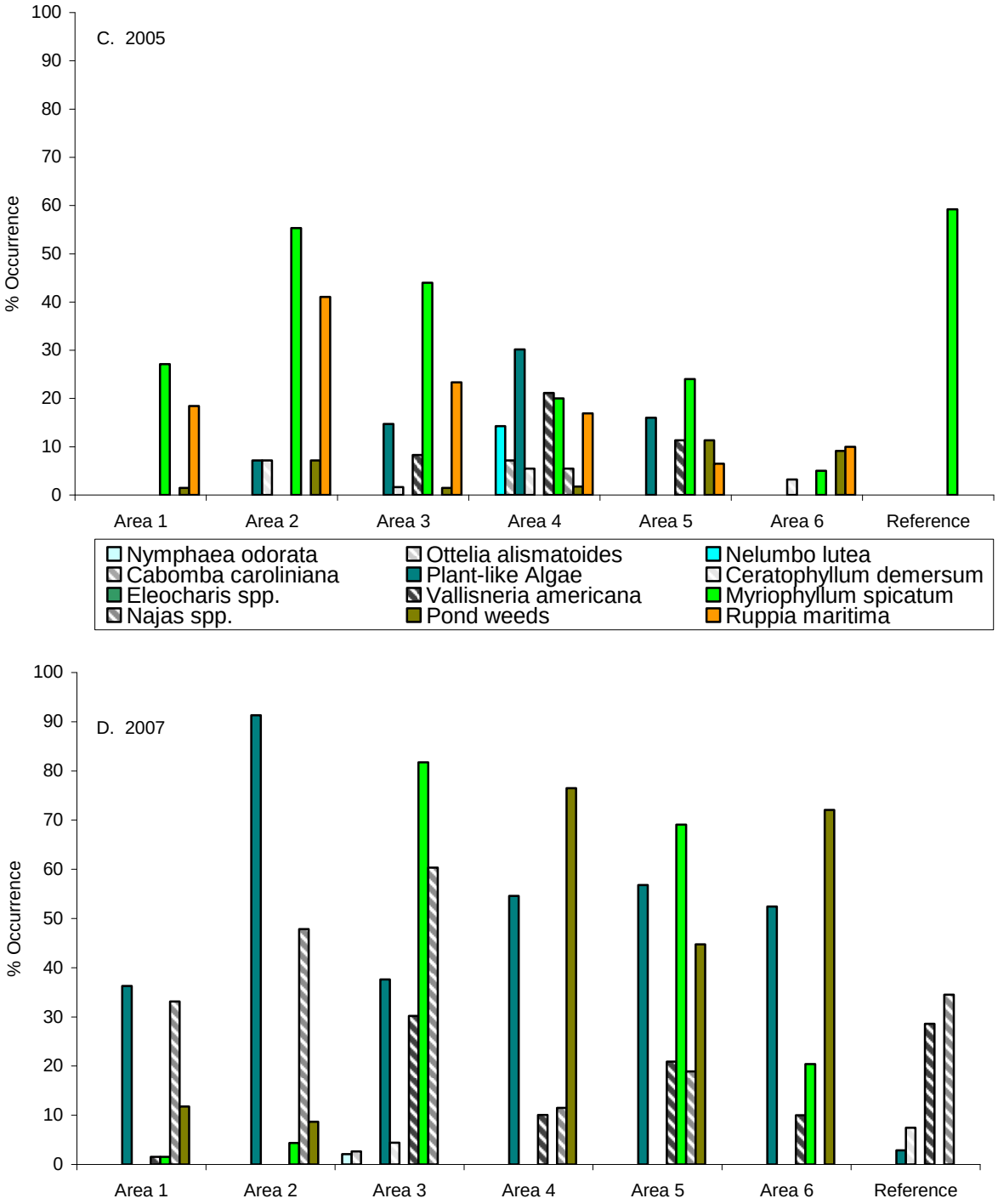


Figure 12. Total percent occurrence of SAV sampled by area and over time in late summer/ early fall. Values are means and standard errors of three transects (n=3) per area for each year except for area 2 in 2003 (n=1), 2005 (n=2), and 2007 (n=1).



Figures 13 a and b. Percent occurrence of SAV species by sample area collected in (A) 1999 and (B) 2003. Values are the mean of transect values (n=3) per area for each year except for area 2 in 2003 (n=1).



Figures 13 c and d. Percent occurrence of SAV species by sample area collected in (C) 2005 and (D) 2007. Values are the mean of transect values (n=3) per area for each year except for area 2 in 2005 (n=2) and 2007 (n=1).

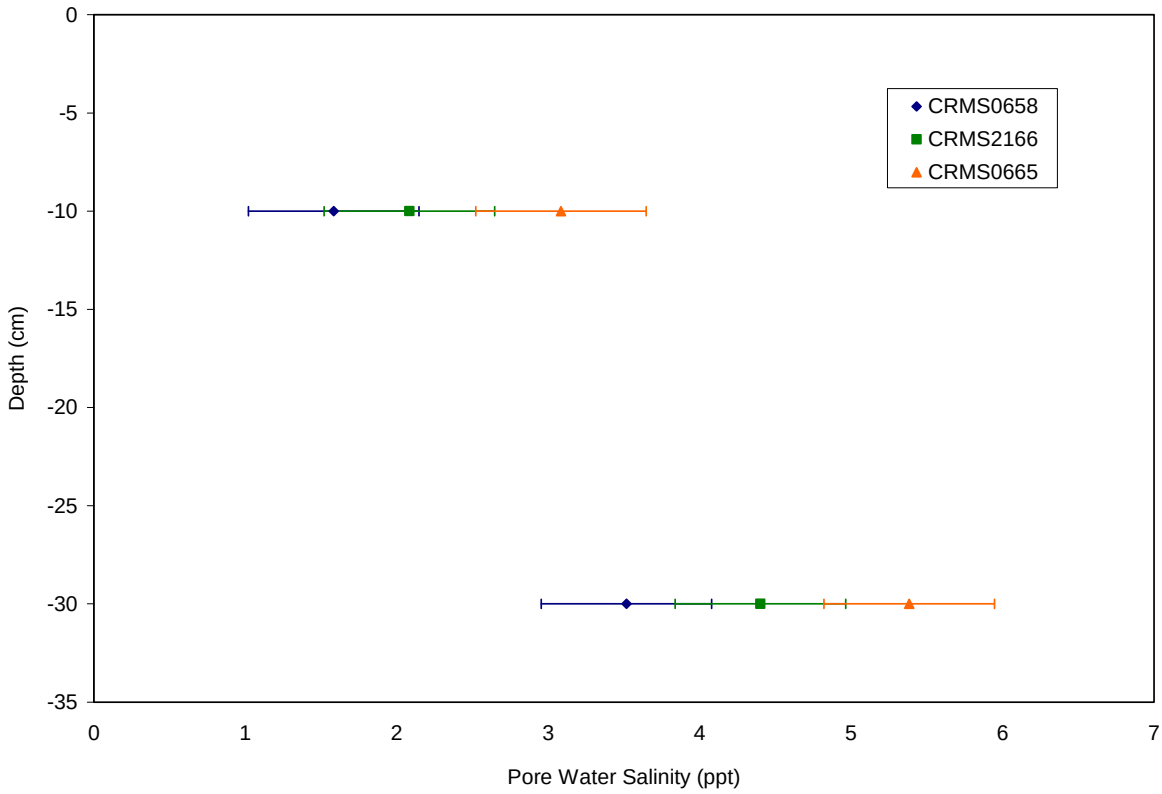


Figure 14. Pore-water salinities collected from CRMS sites in late summer 2007 on either side of Black Bayou (Project Side, 2166; Reference Side, 0665) and between the Black Bayou Cut-off Canal and the impoundment along the GIWW (0658). Values are means and standard errors (least square) from vegetation stations and the sampling platform (n=6).

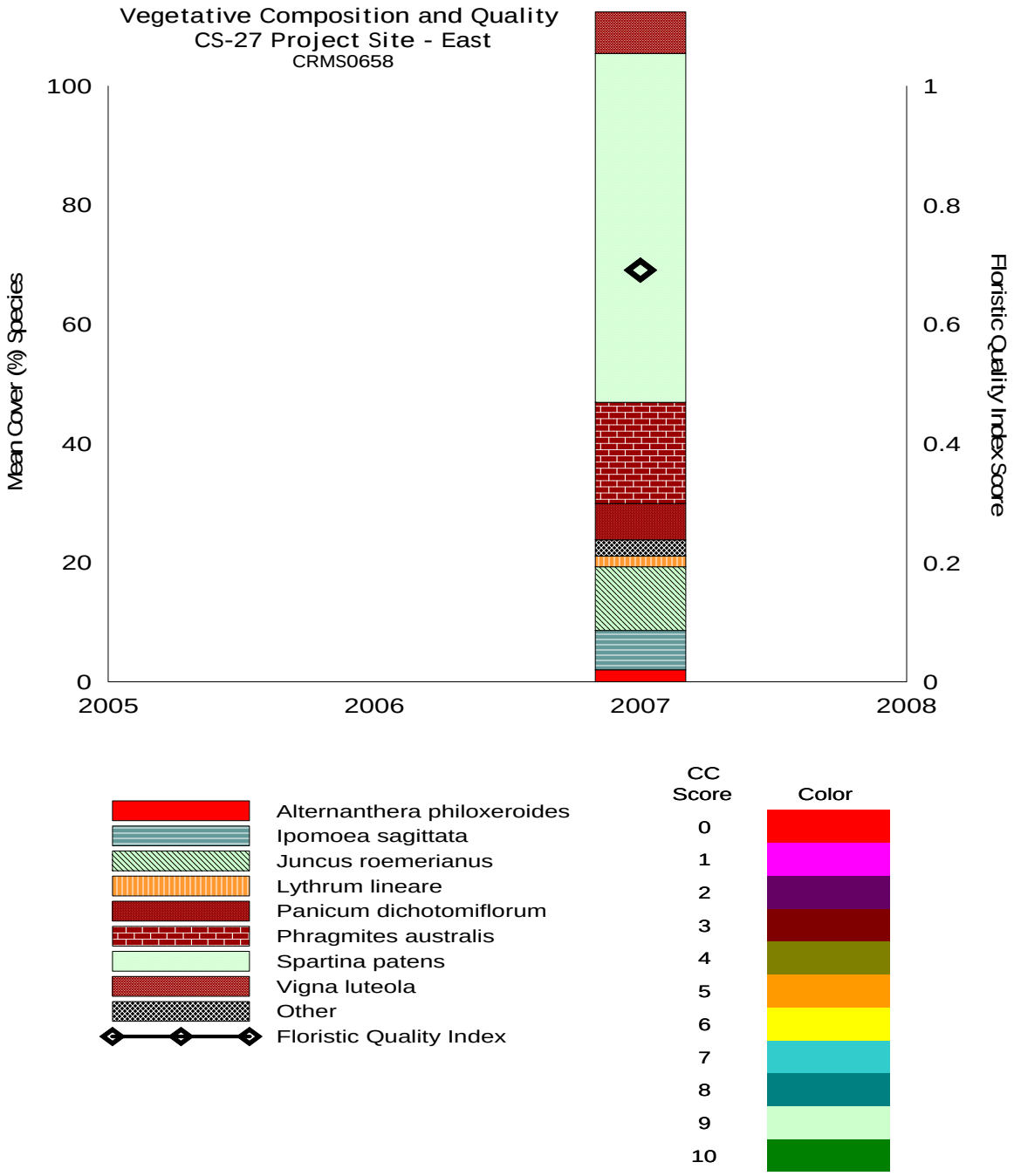


Figure 15 a. Percent coverage of species and floristic quality index of collected from CRMS0658 within the project area between the Black Bayou Cut-off Canal and the impoundment in September 2007. Values are means of 10 stations within the site; therefore, the sum of % coverage of individual species can be greater than 100 %.

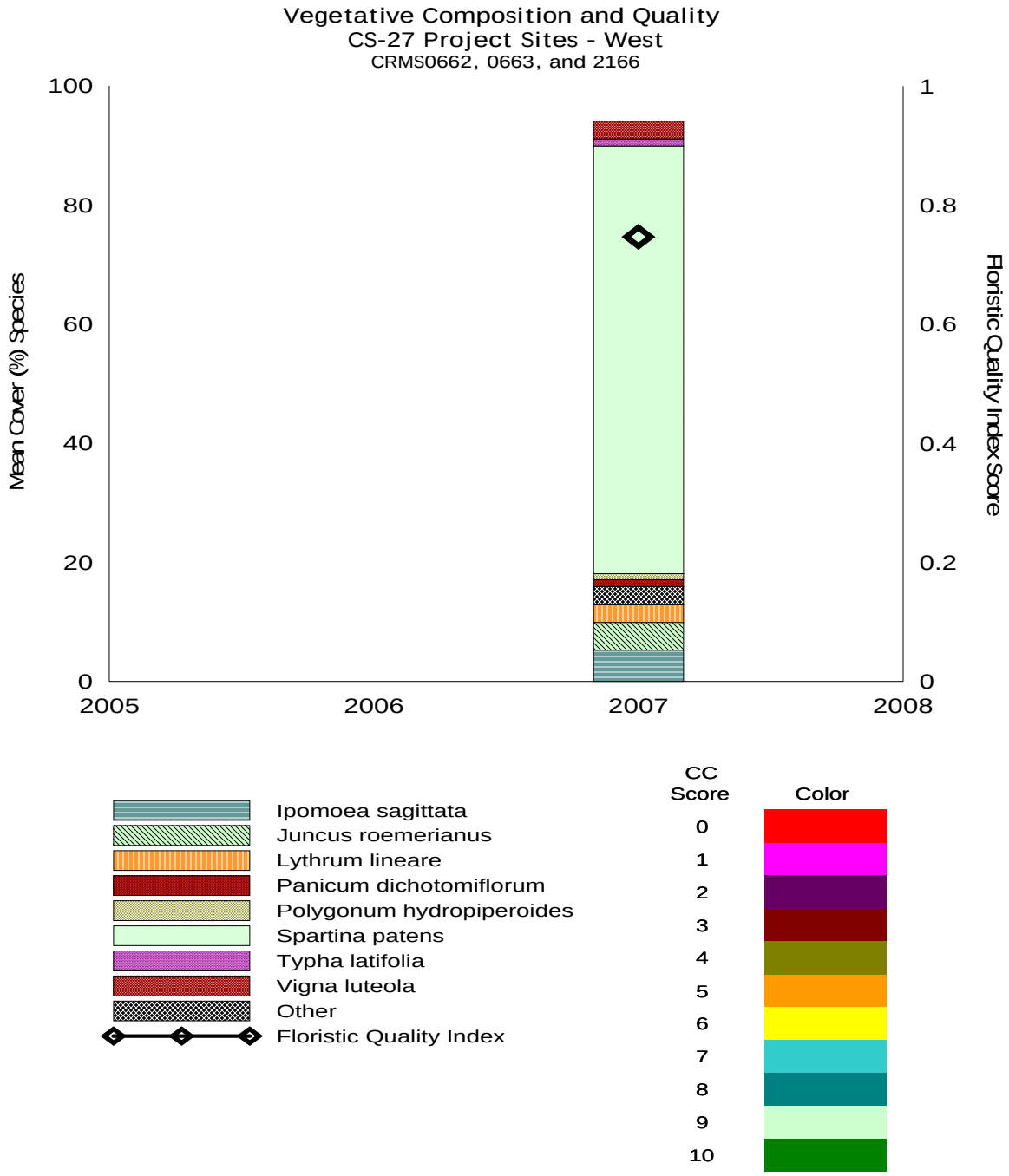


Figure 15 b. Percent coverage of species and floristic quality index of collected from within the west side of the project area September 2007. Values are means of 10 stations within the site; therefore, the sum of % coverage of individual species can be greater than 100 %.

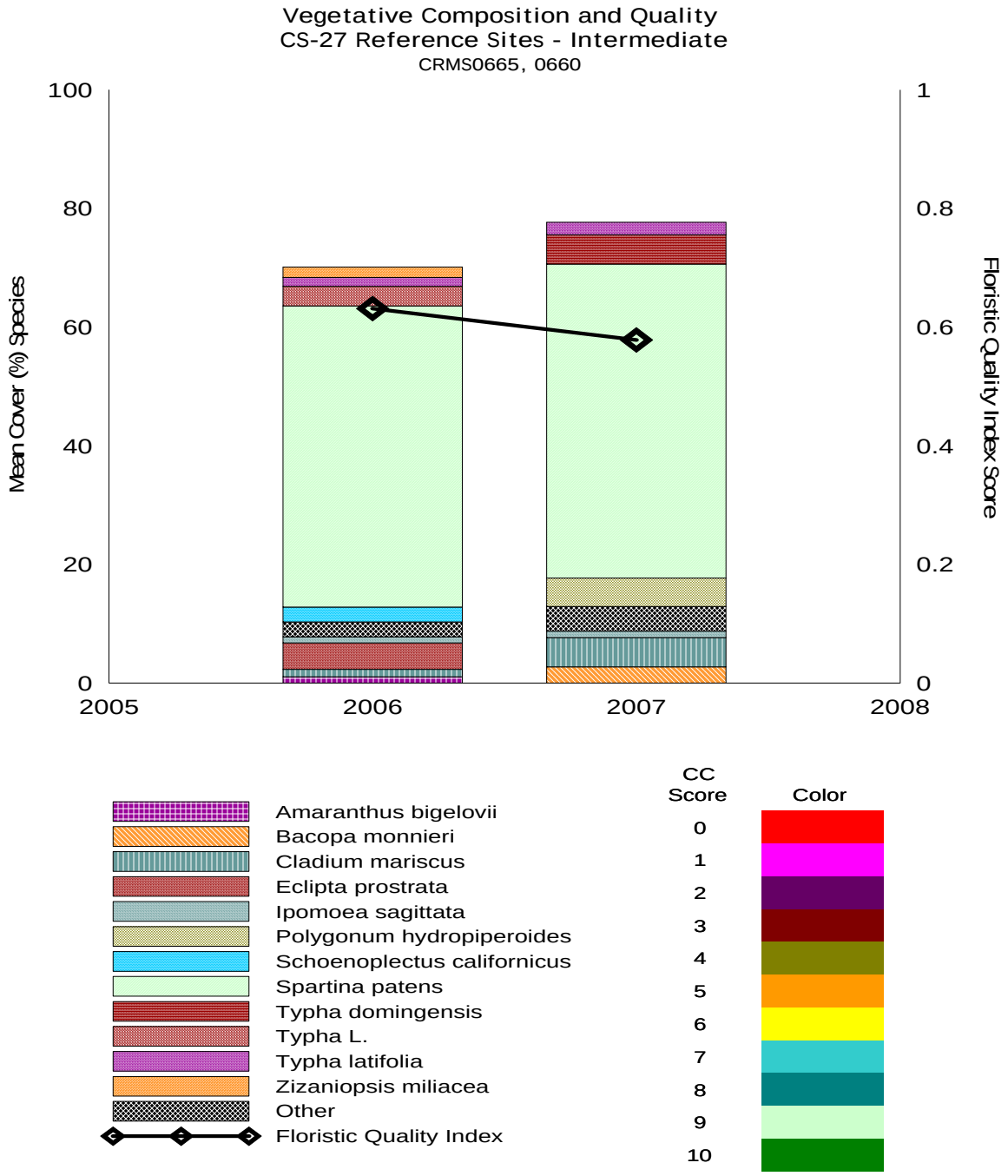


Figure 15 c. Percent coverage of species and floristic quality index of collected south of the project area in September 2006 and 2007. Values are means of 10 stations within the site; therefore, the sum of % coverage of individual species can be greater than 100 %.

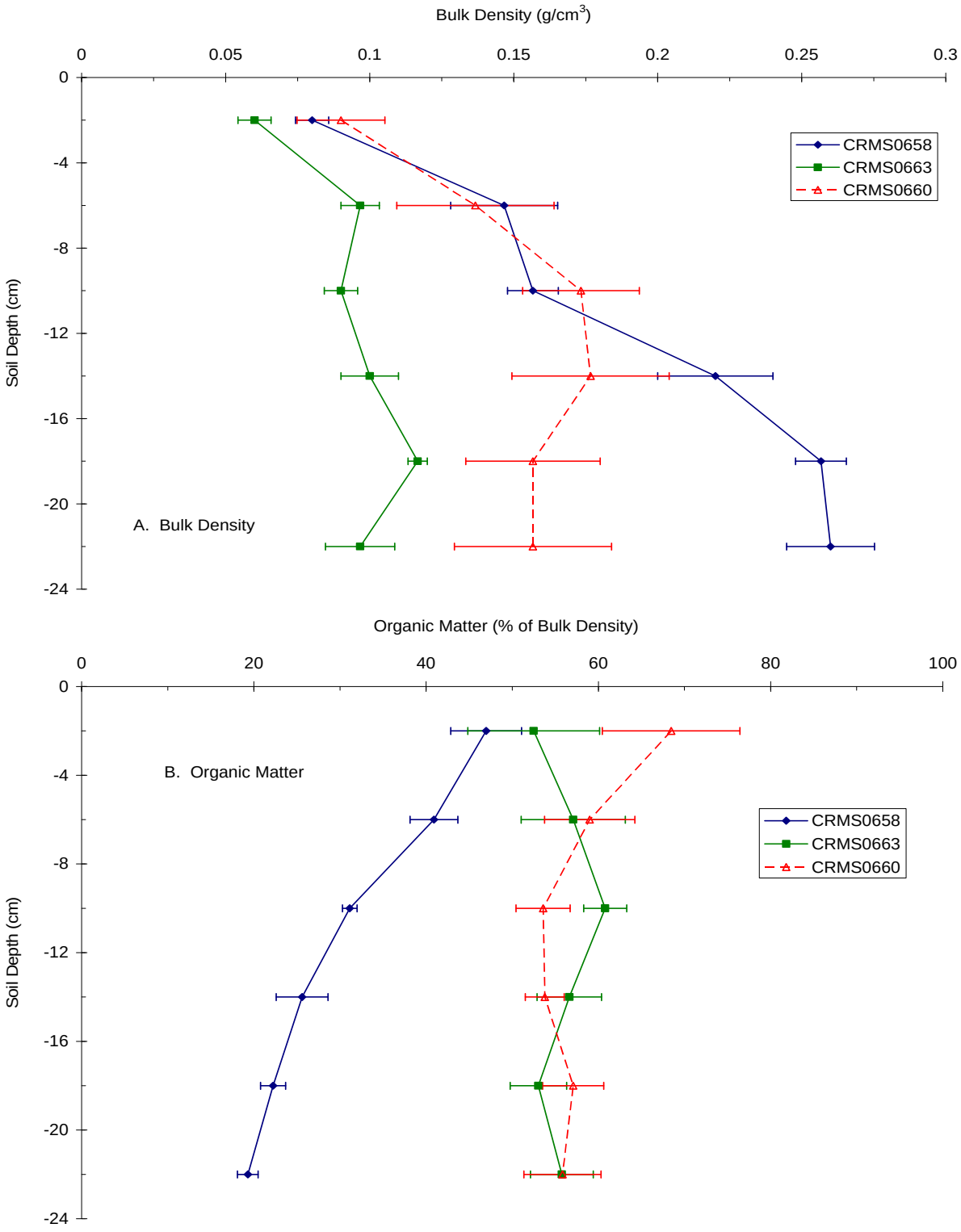


Figure 16. Soil properties (A. bulk density and B. organic matter) collected at CRMS sites inside (CRMS0658, between BBCC and impoundment; CRMS0663, mid and west) and outside (CRMS0660) the project area. Values are means and standard errors (n=3).

V. Conclusions

a. Project Effectiveness

The project has been successful at increasing freshwater retention in order to reduce salinity during normal weather cycles. Mean salinities within the project area were less than the reference area, especially in interior portions of the project area. Salinities were substantially lower inside the project area than the GIWW and slightly lower inside than outside project structures during an inspection trip in November 2007. Within the project area, salinity and water levels were typically higher but less variable inside the impoundment than outside as salinity and water level spikes are attenuated inside the impoundment. Following the surge of salty water from Hurricane Rita, water level (through mid January) and salinity (through July 2006) decreased in the impoundment. Salinity and water level remained higher outside the project area (~8 miles southwest) than in the impoundment through mid-fall of 2006. Unfortunately, no comparable data from this time period is available near the GIWW west of the Calcasieu Ship Channel.

The project area did not lose marsh area soon after project completion in 2001; however, establishment of emergent wetland vegetation was slower than in the reference area from 2000 to 2004. During this time frame, most of bullwhip planted in 2002 and 2003 survived as some plantings were healthy whereas other plantings were deteriorated. Unfortunately, interpretation of land change data is limited by the acceptable error of 5-10% for comparing time intervals. However, trends described by future data collections will be more useful in describing project effects.

The foreshore dike has not only effectively reduced shoreline erosion along the GIWW; but the shoreline has widened along the northern boundary of the impoundment. Overall, this wider shoreline should provide protection to the emergent wetland vegetation within this portion of the project. However, at least one breach still exists which allows for hydrologic exchange and causes localized scouring.

The occurrence of submersed aquatic vegetation (SAV) has been higher in the middle portion than the perimeter portions of the project area and reference area. Among the project areas, the impoundment has recovered the least since Hurricane Rita. Fluctuations over time are attributed climatologic forcing functions on the region, such as drought (1999, 2005) and Hurricane Rita (2005).

The constructed components of the project are in relatively good condition. The functionality of these components, however, has been affected by damages sustained during Hurricane Rita to a levee that runs from the SRT Gate northward to the GIWW. This levee serves as a hydrologic boundary but is not a feature to be maintained. Methods, other than CWPPRA, are being investigated by the local landowners, to repair this levee.

b. Recommended Improvements

The hydrodynamic model developed for project design should be rerun to assess the model validity, and the project validity.

To more effectively evaluate emergent vegetation establishment within the project area, the project area should be divided into sections (at least impoundment and non-impoundment) for land:water analyses in order to specify where change is occurring. GIS based land:water change analyses would also aid in assessing this project goal by visually representing where change is occurring.

For SAV analyses, a mix of larger and smaller water bodies should be sampled in each area when available, especially in area 1 (the impoundment) and the reference area which only have long transects in larger, open-water areas. Occurrence of SAV is typically lower in larger water bodies because of greater wave energy and turbulence and may not represent project effects. Transects selections should be updated based on new aerial photography.

Installation of staff gauges in convenient locations within the project area is still recommended. Warning signs in areas of severe current caused by installation of rock or sheet pile weirs should always be included. These signs should be installed in concrete blocks out of the way of traffic since this has proven to be very effective. Also, railings or fences around water control structures should be considered. Plans and specifications are currently being prepared to address these issues:

- Add bags of concrete to raise the elevation of the rock plug
- Install a new warning sign at Burton Canal
- Address low elevations and gaps in GIWW rock dike and canal closures with concrete bags
- Install staff gauges
- Repair the frozen flap on the SRT Gate.

c. Lessons Learned

Areas, such as the impoundment, designed to hold more water than surrounding areas are difficult to maintain because of the additional hydrodynamic forces. As such, breaches are difficult to stop with conventional measures. The culverts installed in the southeast corner of the impoundment in addition to the SRT gate proved helpful in relieving high water levels after Hurricane Rita.

The continuous hydrologic data sonde for the impoundment is located in a plugged canal near its intersection with the canal where the SRT gate is located. The plugged canal is silting-in which has caused sensor interference in the sonde. The sensor was elevated for a short-term solution, and the sonde will be moved into the SRT gate canal.

Hydrologic recording equipment should be deployed in water bodies that supply the project area with water such as the GIWW, Black Bayou, and the Sabine River to adequately monitor hydrologic conditions throughout an area as large as CS-27 and document short-term, high-salinity events.

Previously scheduled project monitoring should not be discontinued until the new monitoring begins. All project-specific hydrologic monitoring except for the continuous recorder in the impoundment within the project area was discontinued in anticipation of the CRMS network. Unfortunately, the implementation and establishment of the CRMS network was delayed by up to 3 years by unanticipated circumstances such as Hurricane Rita and landowner complications. About three years of hydrologic monitoring potential was lost between the discontinuation of the project monitoring and delays in the implementation of the new monitoring.

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APPENDIX A
(Inspection Photographs)

Photo 1—Navigational Aids and signage at Block's Creek

Photo 2—western side of Block's Creek Structure & signage

Photo 3—erosion on SE end of Block's Creek Structure

Photo 4—Burton Canal Structure

Photo 5—SE rock at Burton Canal Structure

Photo 6—NE rock on Burton Canal Structure

Photo 7—SRT Gate railings, etc.

Photo 8—SRT Gate S end

Photo 9—SRT Gate N end

Photo 10—SRT Gate pillow block on new flap

Photo 11—Rock plug near SRT Gate

Photo 12—Black Bayou Cut-Off Canal Structure; Navigational aids, signs, etc.

Photo 13—Typical section of rock dike

Photo 14—Missing sign at Black Bayou

Photo 15—Missing spoil on W. end of Black Bayou Closure

Photo 16—Missing spoil and gap in rock dike at E. end of Vinton Canal Closure

Photo 17—Gap in E. end of C-stone closure at second gap from the east

APPENDIX B
(Three Year Budget Projection)

BLACK BAYOU HYDROLOGIC RESTORATION/ CS27 / PPL 6

Three-Year Operations & Maintenance Budgets 07/01/2008 - 06/30/2011

Project Manager	O & M Manager	Federal Sponsor	Prepared By
Pat Landry	*Stan Aucoin*	*NMFS*	*Stan Aucoin*

	2008/2009	2009/2010	2010/2011
Maintenance Inspection	$ 5,570.00	$ 3,737.00	$ 3,909.00
Navigational Aid Inspection	$ 3,000.00	$ 3,000.00	$ 3,000.00
Administration	$ 21,591.00	$ 3,288.00	$ 3,315.00
Maintenance/Rehabilitation			

08/09 Description: Repair hinges at SRT, plug gaps in spoil, install staff gage, signage at Burton Canal, cap plug at SRT.

E&D	$ 5,000.00
Construction	$ 220,053.00
Construction Oversight	$ 17,336.00
Sub Total - Maint. And Rehab.	$ 242,389.00

09/10 Description

E&D	$ -
Construction	$ -
Construction Oversight	$ -
Sub Total - Maint. And Rehab.	$ -

10/11 Description:

E&D	$ -
Construction	$ -
Construction Oversight	$ -
Sub Total - Maint. And Rehab.	$ -

	2008/2009	2009/2010	2010/2011
Total O&M Budgets	**$ 272,550.00**	**$ 10,025.00**	**$ 10,224.00**

O &M Budget (3 yr Total)	**$ 292,799.00**
Unexpended O & M Budget	**$ 158,576.00**
Remaining O & M Budget (Projected)	**$ (134,223.00)**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

BLACK BAYOU HYDROLOGIC RESTORATION/CS-27/PPL 6

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$5,570.00	**$5,570.00**
Design Surveys	LUMP	1	$0.00	**$0.00**
Engineering and Design	LUMP	1	$0.00	**$0.00**
Navigational Aid Inspection	LUMP	1	$3,000.00	**$3,000.00**
Construction Oversight	LUMP	1	$17,336.00	**$17,336.00**

ADMINISTRATION

LDNR / CRD Admin.	LUMP	1	$12,330.00	$12,330.00
FEDERAL SPONSER Admin.	LUMP	1	$9,261.00	$9,261.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$21,591.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:	INSTALL ONE STAFF GAUGE NEAR BURTON CANAL				
	Secondary Monument	EACH	0	$0.00	$0.00
	Staff Gauge / Recorders	EACH	1	$5,000.00	$5,000.00
	Marsh Elevation / Topography	LUMP	0	$0.00	$0.00
	TBM Installation	EACH	0	$0.00	$0.00
	OTHER				$0.00
				TOTAL SURVEY COSTS:	**$5,000.00**

GEOTECHNICAL

GEOTECH DESCRIPTION:					
	Borings	EACH	0	$0.00	$0.00
	OTHER				$0.00
				TOTAL GEOTECHNICAL COSTS:	**$0.00**

CONSTRUCTION

CONSTRUCTION DESCRIPTION:	REPAIR BREACHES/LOW SPOTS ON GIWW AND ROCK PLUG; INSTALL SIGN AT BURTON CANAL					
	Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
	Graded Stone- Bankline	0	1.0	0	$0.00	$0.00
	610 Limestone-Compacted Fill		1.0	0		$0.00
		0	0.0	0	$0.00	$0.00
	Filter Cloth / Geogrid Fabric		SQ YD	304	$7.00	$2,128.00
	Navagation Aid		EACH	0	$0.00	$0.00
	Signage		EACH	2	$4,500.00	$9,000.00
	General Excavation / Fill		LUMP	1	$0.00	$0.00
	Dredging		CU YD	0	$0.00	$0.00
	Sheet Piles (Lin Ft or Sq Yds)			0	$0.00	$0.00
	Corrugated Alum. Pipe (30")		LF	0	$0.00	$0.00
	Aluminum Flap Gate		EACH	0	$0.00	$0.00
	Fabricate & Install 2 SS Flap Gates		LUMP	0	$0.00	$0.00
	Materials		LUMP	0	$0.00	$0.00
	Mob / Demob		LUMP	1	$22,500.00	$22,500.00
	Contingency		LUMP	1	$36,675.00	$36,675.00
	General Structure Maintenance		LUMP	1	$8,000.00	$8,000.00
	BAGS OF CONCRETE AT GAPS		Each	7,875	$18.00	$141,750.00
					TOTAL CONSTRUCTION COSTS:	**$220,053.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$272,550.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET 07/01/2009-06/30/2010

BLACK BAYOU HYDROLOGIC RESTORATION/CS-27/PPL 6

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$3,737.00	**$3,737.00**
General Structure Maintenance	LUMP	1	$0.00	**$0.00**
Engineering and Design (12% of construction)	LUMP	1	$0.00	**$0.00**
Navigational Aid Inspection	LUMP	1	$3,000.00	**$3,000.00**
Construction Oversight (12% of construction)	LUMP	1	$0.00	**$0.00**

ADMINISTRATION

LDNR / CRD Admin. (6% of construction)	LUMP	1	$0.00	$0.00
FEDERAL SPONSER Admin.	LUMP	1	$3,288.00	$3,288.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$3,288.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:	INSTALL ONE STAFF GAUGE NEAR THE ROCK ON THE GIWW AND ONE AT BURTON CANAL				
	Secondary Monument	EACH	0	$0.00	$0.00
	Staff Gauge / Recorders	EACH	0	$0.00	$0.00
	Marsh Elevation / Topography	LUMP	0	$0.00	$0.00
	TBM Installation	EACH	0	$0.00	$0.00
	OTHER				$0.00
				TOTAL SURVEY COSTS:	**$0.00**

GEOTECHNICAL

GEOTECH DESCRIPTION:					
	Borings	EACH	0	$0.00	$0.00
	OTHER				$0.00
				TOTAL GEOTECHNICAL COSTS:	**$0.00**

CONSTRUCTION

CONSTRUCTION DESCRIPTION:	REPAIR BREACHES/LOW SPOTS ON GIWW AND ROCK PLUG; INSTALL SIGN AT BURTON CANAL					
	Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
	Graded Stone- Bankline	0	1.0	0	$0.00	$0.00
	610 Limestone-Compacted Fill		1.0	0	$0.00	$0.00
		0	0.0	0	$0.00	$0.00
	Filter Cloth / Geogrid Fabric		SQ YD	0	$0.00	$0.00
	Navagation Aid		EACH	0	$0.00	$0.00
	Signage		EACH	1	$0.00	$0.00
	General Excavation / Fill		LUMP	1	$0.00	$0.00
	Dredging		CU YD	0	$0.00	$0.00
	Sheet Piles (Lin Ft or Sq Yds)			0	$0.00	$0.00
	Corrugated Alum. Pipe (30")		LF	0	$0.00	$0.00
	Aluminum Flap Gate		EACH	0	$0.00	$0.00
	Fabricate & Install 2 SS Flap Gates		LUMP	0	$0.00	$0.00
	Materials		LUMP	0	$0.00	$0.00
	Mob / Demob		LUMP	1	$0.00	$0.00
	Contingency		LUMP	1	$0.00	$0.00
	General Structure Maintenance		LUMP	1	$0.00	$0.00
	900 BAGS OF CONCRETE AT LARGE GAP		900		$0.00	$0.00
	200 BAGS AT PLUG		200		$0.00	$0.00
	100 BAGS AT ALLIGATOR CROSSING		100		$0.00	$0.00
					TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$10,025.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET 07/01/2010-06/30/2011

BLACK BAYOU HYDROLOGIC RESTORATION/CS-27/PPL 6

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$3,909.00	**$3,909.00**
General Structure Maintenance	LUMP	1	$0.00	**$0.00**
Engineering and Design (12% of construction)	LUMP	1	$0.00	**$0.00**
Navigational Aid Inspection	LUMP	1	$3,000.00	**$3,000.00**
Construction Oversight (12% of construction)	LUMP	1	$0.00	**$0.00**

ADMINISTRATION

LDNR / CRD Admin. (6% of construction)	LUMP	1	$0.00	$0.00
FEDERAL SPONSER Admin.	LUMP	1	$3,315.00	$3,315.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$3,315.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary Monument	EACH	0	$0.00	$0.00
Staff Gauge / Recorders	EACH	0	$0.00	$0.00
Marsh Elevation / Topography	LUMP	0	$0.00	$0.00
TBM Installation	EACH	0	$0.00	$0.00
OTHER				$0.00
			TOTAL SURVEY COSTS:	**$0.00**

GEOTECHNICAL

GEOTECH DESCRIPTION:					
Borings	EACH	0	$0.00	$0.00
OTHER				$0.00
			TOTAL GEOTECHNICAL COSTS:	**$0.00**

CONSTRUCTION

CONSTRUCTION DESCRIPTION:					
Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
Graded Stone- Bankline	0	1.0	0	$0.00	$0.00
610 Limestone-Compacted Fill		1.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
Filter Cloth / Geogrid Fabric		SQ YD	0	$0.00	$0.00
Navagation Aid		EACH	0	$0.00	$0.00
Signage		EACH	1	$0.00	$0.00
General Excavation / Fill		LUMP	1	$0.00	$0.00
Dredging		CU YD	0	$0.00	$0.00
Sheet Piles (Lin Ft or Sq Yds)			0	$0.00	$0.00
Corrugated Alum. Pipe (30")		LF	0	$0.00	$0.00
Aluminum Flap Gate		EACH	0	$0.00	$0.00
Fabricate & Install 2 SS Flap Gates		LUMP	0	$0.00	$0.00
Materials		LUMP	0	$0.00	$0.00
Mob / Demob		LUMP	1	$0.00	$0.00
Contingency		LUMP	1	$0.00	$0.00
General Structure Maintenance		LUMP	1	$0.00	$0.00
900 BAGS OF CONCRETE AT LARGE GAP		900		$0.00	$0.00
200 BAGS AT PLUG		200		$0.00	$0.00
100 BAGS AT ALLIGATOR CROSSING		100		$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$10,224.00**

APPENDIX C
(Field Inspection Notes)

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name:CS-27 Black Bayou Hydrologic Restoration

Date of Inspection: November 27, 2007 Time: 11:30 am

Structure No. ___ N/A

Inspector(s):Stan Aucoin, Mel Guidry, Darrell Pontiff (OCPR)
Tommy McGinnis (OCPR), Dale Garber (NRCS)

Structure Description: Rock Dike, SRT Gate, Rock Plug, Boat Bay

Water Level Inside:_____ Outside: _____

Type of Inspection: Annual

Weather Conditions:sunny and mild

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps					
Steel Grating					
Stop Logs					
Hardware					Staff gauges will have to be re-established at selected locations.
Timber Piles Burton Canal	Good				These piling pose a collision hazard with swift current.
Timber Wales					
Galv. Pile Caps					
SRT Gate	Good				
Signage /Supports Vinton Canal					Signs missing at Vinton Canal and Black Bayou closures along GIWW.
Rip Rap (fill) Rock Dike at GIWW	Fair				Gap in spoil and rock at Vinton Canal Alligator crossing at 3rd closure from east and breach in 2nd closure from east need to be repaired. Several low areas on dike where rock was apparently pushed back by a barge.
Block's Creek Rock Plug	Good Fair				Plug has settled to ~+2.5' and will need to be lifted slightly.

What are the conditions of the existing levees?
Are there any noticeable breaches?
Settlement of rock plugs and rock weirs?
Position of stoplogs at the time of the inspection?
Are there any signs of vandalism? Yes, signs missing.